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THE

PREFACE.

THE known abilities of the Author, and the Good Reception the Firſt Edition of this his Treatiſe of *Arithmetick* has met with, even in this Learned Age, and the great Demand for the Book, being a greater Encouragement for the Book-ſellers to publiſh this Second Edition, than any Recommendation whatever: I ſhall only acquaint the Reader with the Author's Method, which of the many others hitherto publiſhed, ſeems to be the moſt Happy and Advantageous,

tageous, either with Reſpect to the Subject or Learner.

Firſt, Mr. ROYER, has explained in a plain accurate and ſuccinct Manner, all the Rules of *Vulgar Arithmetick* and *Fractions.*

Secondly, He has ſo treated the *Decimal Arithmetick*, as to make it plain to the meaneſt Capacity; and under the proper Rules ſhewn the Menſuration of Superficies and Solids, as alſo the Calculation of Intereſt, both Simple and Compound. And laſtly, he has added a Collection of Pleaſant and uſeful Queſtions, in *Vulgar* and *Decimal Arithmetick*, and in *Arithmetical* and *Geometrical* Progreſſion; all which from his long Experience in Teaching, he has rendred very plain and eaſie.

PREFACE.

The Author being dead (at the Requeſt of the Book-ſeller) I have taken the Care of the Preſs in this Second Edition; and have added thereto *a Compendium of Algebra*, beginning with the firſt Rudiments, and proceeding gradually through the ſeveral Parts; plainly ſhewing how to Form, and bring any Problem to an Equation, and the Way to Reſolve that Equation into Numbers, whether the Equation be Simple, Quadratick, Cubick, or Biquadratick, &c. In all which I have purpoſely deſigned to render the Manner of Solution intelligible to a Mean Capacity; that being the principal Thing which the learned Authors on this Subject have been deficient in.

The *Geometrical* Conſtruction of Equations, could not be added to this Book, without encreaſing the Bulk and Price above the Book-ſeller's Deſign; but the Reader may expect a Syſtem of *Algebra* (which I have now in hand) with *Geometrical* Demonſtrations of all the Rules, which I preſume is a Thing intirely new, together with Conſtructions of the ſeveral Equations: In which the Queſtions made Uſe of, in the ſeveral Degrees of Equations, ſhall not be meerly Speculative, but applied to thoſe Things that are of Uſe in Life, and for the advantage of Mankind.

Channel-Row,
Jan. 1ſt, 1727-8.

George Gordon.

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Arith-

Arithmetick.

❀ ❀

CHAP. I.

Of Numeration.

1. N*UMERATION* is the Art of numbring well; as Magnitude or Greatneſs is the Subject of Geometry; Multitude or Number, is that of Arithmetick.

2. Number is that by which every Thing is ſet down, written, or expreſſed, and are written down with ten Figures, or Characters as 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, one, two, three, four, five, ſix, ſeven, eight, nine, nothing; the nine firſt Figures are called ſignificant Figures.

3. The Cypher or 0, is the laſt, which though of itſelf it ſignifies nothing, yet being joined after any of the ſignificant Figures, it increaſeth their value, as will more fully appear by the following Table,

which Arithmeticians therefore very properly call the Numeration Table, which at the firſt View, ſheweth all Manner of Computation by Numbers.

The Numeration Table.

Left-hand

1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
C. Millions.	X. Millions.	Millions.	C. Thouſands.	X. Thouſands.	Thouſands.	Hundreds.	Tens.	Units.
9	8	7	6	5	4	3	2	1

Right-hand

N. B. By this Table you may perceive, how that all Arithmetick uſed by theſe numeral Figures, are to be read from the Right-hand to the Left, becauſe 'twas the *Arabians* who firſt invented this Arithmetick, whoſe Reading is from the Right-hand towards the Left; contrary to the Southern Nations.

The Explanation of the ſaid Table.

5. Under-againſt every Place of the Numbers in the foregoing Table, is written (in Words at length) the Value thereof; *viz.* Units, Tens, Hundreds, Thouſands, *&c.* which Words ought to be perfectly gotten by heart, and being well underſtood, the Learner will be the better enabled to expreſs, or write down the Value of any Number written or named.

6. *Note,* Although this Table be made to conſiſt but of nine Places, yet it may be continued to as many Places as you pleaſe; only obſerving that the Value of every Place is ten Times as much as that which goeth before it. So the tenth Place is Thouſands of Millions, the eleventh Place is Tens of Thouſands of Millions, the twelfth Place is Hundreds of Thouſands of Millions, and the thirteenth Place is Millions of Millions; and in that Order you may conceive Places, to be continued infinitely from the Right-hand towards the Left.

7. From the Rules aforegoing, you may read, or write down any Number of Figures, that is propoſed to you. As for Example, ſet down One thouſand, five hundred, forty-nine thus, 1549, as alſo One hundred, twenty-three millions, four hundred fifty-ſix thouſand ſeven hundred eighty-nine, thus, 123456789. And as this, ſo any other Number may be ſet down or pronounced.

Period 8. There is now (among Merchants, and Accomptants) another Method, that is very plain and uſeful, in the expreſſing of great Numbers, conſiſting of many Places, which is thus, firſt diſtinguiſhed by a Comma or Point, (which may be call'd Periods) between every three Figures, reckoning in Order from the Right-hand towards the Left, *viz.*

Let this Number be propoſed conſiſting of fourteen Places, *viz.* 84*6*39042724*536*, and when every third Figure is pointed, it will ſtand thus, 84.*639*.042.724.*536*. every three Figures being call'd a Period, the firſt Period (which is *536*.) *viz.* five hundred, thirty-ſix, and every other Period is to be read in every Reſpect, as if it ſtood in the firſt Place of the Period, only in expreſſing the Value of the ſecond Place, you muſt add there the Word thouſand; to the third Period you muſt add the Word Millions; to the fourth Period, Thouſands of Millions; to the fifth, Millions of Millions, and ſo the Number before propoſed, is to be read as followeth;

Eighty-four millions of millions, ſix hundred thirty-nine thouſand, forty-two millions, ſeven hundred twenty-four thouſand, five hundred, thirty-ſix.

9. The uſe of a Cypher, is (by filling a Place in that Number) to augment the Value of other Figures.

10. One (or more Cyphers) in the laſt Place of any Number towards the Left-hand (as in theſe 0245, 0093, 0004*6*) is uſeleſs, becauſe no ſignificant Number is thereby advanced to a more valuable Place.

11. A Cypher in any other Place adds to the Value of the Number, *viz.* in 2200; for by annexing theſe two Cyphers, they become two thouſand, and two hundred; and ſo this Number 400301, is four hundred thouſand, three hundred and one.

12. It is (by the readily learning of your Table) ſuppoſed you can ſet down any Number propoſed, for which Purpoſe and Practiſe, I ſhall ſet down, ſome Numbers to make you perfect; namely, ſet down three-ſcore thus, *6*0. Set down ſix-ſcore thus, 120. Set down one thouſand, ſeven hundred and nine thus, 17*09*: Again, ſet down eleven thouſand, eleven Hundred and eleven, thus, 12111.

Let it be required to ſet down eleven millions, eleven hundred, and eleven thouſand, eleven hundred, and eleven, thus 12112111, a little Practice will make you perfect.

N. B. The true ſetting down, the Value of any Number written or named, depends principally upon a right underſtanding of the three firſt Places in the Numeration-Table; and therefore I ſhall adviſe the Learner to be well exerciſed therein before he proceeds further.

Thus much as briefly and plainly I have finiſhed *Numeration.*

CHAP. II.

Of Addition of Integers or whole Numbers.

THE Number found by Addition, is called the Sum, or total of divers Numbers put together, as 5 and 7 are 12, as alſo the Sum of 7, 4, and 11 put together, are 22.

2. In Addition, place the Numbers given one above another in ſuch Sort, that like Places or Degrees in each Number, may ſtand in the ſame Rank; that is, Units under Units, Tens under Tens, Hundreds under Hundreds, Thouſands under Thouſands, *&c.*

As for EXAMPLE.

l.
What is the Sum of 457
316
245
932
764

Anſwer 2714

So the Numbers 457, 316, 245, 932, and 764, being given, to be added they will make the Sum 2714, or two thouſand ſeven hundred, and fourteen.

A Second EXAMPLE.

Add 4607, 8628, 6845, 3130, being given to be be added together, the Operations will ſtand as followeth;

l.
4607
8628
6845
3130

23210

The Operation.

The Figures in the firſt Rank making 20, I ſet down 0 under the ſame Rank, and carry 2 to the next Place, which makes 11, I ſet down 1, and carry 1 to the third Place, which making 22, I ſet down 2, the Exceſs, and carry 2 to the fourth Place;

which ſaid 2, and the Figures in the fourth Rank making 23, I ſet all down toward the Left-hand of the Figures before ſubſcribed; ſo the Sum of the four Numbers given are 23210.

Number to be added are,

	l.	*l.*	*l.*	*l.*
	56	432	7100	5201
	23	127	1274	1134
	91	214	2901	4127
	74	362	9127	7514
	45	431	7216	9651
	67	554	6141	6125
				2476
	356	2120	33759	36228
The	300	1688	26659	31027
Proof	356	2120	33759	36228

To prove your Addition after you have added up your whole Sum, draw a Line with your Pen under the uppermoſt Number; and when you have ſo done, add all the other Numbers, except the uppermoſt; and when you have ſo done, add the Amount or Sum thereof, to the uppermoſt Sum above the the Line; and if that Sum be the ſame with the Sum firſt found, your work is true, otherwiſe not; as in thoſe Examples before expreſſed.

Of MONEY.

WHEN the Numbers to be added together, are of divers Denominations, you muſt place the given Numbers in ſuch Order, one under another, that each Rank or Degree may conſiſt of one and the ſame Denomination; that is to ſay, if it be in Money, let Pounds be under Pounds, Shillings under Shillings, Pence under Pence, Farthings under Farthings, The like muſt be done in *Weights, Meaſure, Time,* &c.

As for EXAMPLE.

	l.	*s.*	*d.*	
Let it be required to add	46 :	13 :	4 :	$\frac{1}{2}$
	27 :	17 :	7 :	$\frac{1}{4}$
	36 :	02 :	3 :	$\frac{3}{1}$
	10 :	06 :	9 :	$\frac{1}{2}$
	121 :	00 :	1 :	0

	l.	*s.*	*d.*	*far.*
The Sum is	121 :	00 :	1 :	0

Thus found, I begin with Farthings firſt, wherein I find juſt 8 Farthings, which is two Pence, therefore I ſet down 00 in the Farthings, and carry the 2 Pence to the Pence, which with the Number of Pence, as 9, 3, 7, 4, makes 25 Pence, which is two Shillings and one Peny, ſo ſetting down the 1 Peny, I carry two to the Shillings; ſaying, 2 that I carry and 6 is 8, and 8 and 2 is 10, and 7 is 17, and 3 is 20; ſo I ſet 0 in the Units Place of Shillings, and carry 2 Angels to the Angels Place, which with 2

2 Angels more, makes 4 Angels or two Pounds (an Angel is 10 *s.*) which ſaid 2 *l.* I carry to the Pounds Place, ſaying 2 and 6, 7, and 6 is 21, ſo I ſet down 1, and carry 2 to the laſt Place of Pounds, which with 1, 3, 2, 4, makes 12, and by ſetting down 12 in the ſame Line or Rank; ſo the whole Work is finiſhed, and I find the Sum to be 121 *l.* 00 *s.* 01 *d.* 00 *q.*

By ſetting down ſome more Examples for the Learners Practice, he may perfect himſelf; for by caſting up theſe Sums in *Addition of Money*, you may learn to caſt up your Bills.

	l.	*s.*	*d.*	*fa.*	*l.*	*s.*	*d.*	*fa.*
					174	16	09·	2·
	29	15	03·	1	279	19	07·	1
	13	19	02	1	16	13	09	0
	45	17	10·	0	58	12	02·	3·
	67	16	03	3·	3	07	10	2
	32	05	05	2	2	14	11·	1
Sum	189	14	00	3	536	05	02	1
	159	18	02	2	361	08	04	3
Proof	189	14	00	3	536	05	02	1

To prove your Addition after you have caſt up your whole Sum, draw a Line under your uppermoſt Number or Sum, as before directed in your *Addition of Integers.* So I proceed to *Addition of Avoirdupois-Weight.*

Avoir-

Averdupois-Weight.

NOTE, That 16 Drams makes an Ounce, 16 Ounces is a Pound, 28 Pounds makes a Quarter of an Hundred Weight, four Quarters is an Hundred Weight, (conſiſting of 112 Pounds,) and 20 Hundred is a Tun *Avoirdupois-Weight.*

As for EXAMPLE.

		20	4	28
	Tuns	C.	*qrs.*	℔
	5	16	2	15
	2	10	1	12
	7	14	0	20
	4	09	1	09
	6	05	2	10
	3	07	3	02
Sum	30	03	3	12
	24	07	0	25
Proof	30	03	3	12

	4	28	16
C.	*qrs*	℔	*oz.*
13	1	15	09
15	0	12	07
67	1	09	06
7	0	06	05
4	2	18	09
3	3	02	12
9	1	20	06
120	3	01	06
107	1	13	13
120	3	01	06

Troy-Weight.

NOTE, That 24 Grains is a Penny-weight, 20 Penny-weight is an Ounce, and 12 Ounces is a Pound *Troy*.

As for EXAMPLE.

		12	20	24
	℔	*oz.*	*pw.*	*gr.*
	24	09	06	11
	164	10	14	18
	82	07	17	20
	8	18	18	22
Sum	280	00	17	23

	12	20	24
℔	*oz.*	*pw.*	*gr.*
30	11·	12	16
29	10·	07·	08·
56	09·	05	12
73	08	09	09
191	03	14	21

		12	20	24
	℔	*oz.*	*pw.*	*gr.*
	17	09	07·	07
	16	07	09	08
	9	05·	15	20·
	5	06	11·	12·
	4	01	07	06
	7	10·	09	10
Sum	61	05	00	15

Apothecaries-Weight.

NOTE, That 20 Grains make a Scruple, 3 Scruples one Dram, 8 Drams one Ounce, 12 Ounces one Pound.

		12	8	3	20
	℔	*oz.*	*drams*	*ſcrup.*	*Gr.*
	4	09·	5·	1·	13·
	3	07·	2	0	10
	2	04	3·	2	08·
	5	03	4	1·	12
Sum	16	01	0	0	93

Cloth-Measure.

NOTE, That 4 Nails makes one Quarter of a Yard, 4 Quarters one Yard, 5 Quarters one Ell *Engliſh*, and 3 Quarters one Ell *Flemiſh*.

	4	4
Yds	*quart.*	*nai.*
27	2·	3·
14	1	2
96	0	1·
75	1	0
23	3·	3
237	1	1

	5	4
Ells Eng.	*quart.*	*nai.*
36	3·	2
27	4	0
75	2	3·
56	3·	1
92	1	0
288	4	2

Wine-Meaſure.

NOTE, That two Pints is a Quart, 2 Quarts a Pottle, 2 Pottles 1 Gallon, 42 Gallons is a Tierce, or third Part of a Pipe or But, 63 Gallons is a Hogſhead, 2 Hogſheads is a Pipe or But, and 2 Pipes or Buts is a Tun of Wine.

As for EXAMPLE.

	2	63	8
Tuns	*hhds*	*gall.*	*pts*
45	1	09	7
21	0	07	1·
72	0	08	2
53	0	12	5
97	1·	06	3·
69	0	05	1
16	1	10	4
374	1	59	7

	2	63	8
Tuns	*hhds*	*gall.*	*pts*
36	0	14	3·
72	1·	08	2
54	0	06	5·
3	1	05	4
2	0	02	3·
1	1·	03	2
6	0	10	1
2	1	01	4
178	0	52	0

Note alſo, In *Wine-Meaſure*, there is eſteemed or reckoned, that 8 Gallons is a Firkin of Ale, 9 Gallons is a Firkin of Beer, 2 Firkins is a Kilderkin, and 2 Kilderkins is a Barrel, 18 Gallons and a half a Runlet.

Dry-Meaſure.

NOTE, That 2 Pints is a Quart, 2 Quarts a Pottle, 2 Pottles a Gallon, 2 Gallons a Peck, 4 Pecks 1 Buſhel *Land-Meaſure*, 5 Pecks 1 Buſhel *Water-Meaſure*, 8 Buſhels 1 Quarter, 4 Quarters 1 Chalder, 5 Quarters 1 Wey.

Note, That 36 Buſhels is a Chaldron of Sea-Coal in *London*.

As for EXAMPLE.

Chald.	4 *qrs.*	8 *Buſh.*	4 *Pks.*
48	3	5	2
12	1	4	0
91	2	3	1
74	0	6	0
67	1	1	3
52	3	4	2
49	2	1	1
396	3	2	1

Chald.	4 *qrs.*	8 *Buſh.*	4 *Pks.*
64	2	3	2
15	1	1	1
72	0	4	0
9	2	5	1
5	1	6	2
4	3	2	1
7	2	3	0
179	2	1	3

Long-Meaſure.

NOTE, 3 Barley-corns makes 1 Inch, 12 Inches 1 Foot, 3 Feet 1 Yard, 5 Yards and half a Perch or Pole, 40 Perches makes 1 Furlong, 8 Furlongs 1 *Engliſh* Mile, 1760 Yards makes a Mile.

As for EXAMPLE.

	3	12	3
Yards	*Feet*	*Inch*	*Barley*
326	2	10	1
127	1	09	0
414	2	07	1
732	0	11	0
256	1	01	2
514	0	10	1
937	2	03	0
3310	0	04	2

	8	40
Miles	*Fur.*	*Perches*
39	4	16
79	5	10
64	2	09
3	7	12
7	1	08
9	4	01
6	0	07
2	3	10
212	3	33

Land-Meaſure.

NOTE, That 40 ſquare Poles or Perches, makes a Rood, and four Roods maketh an Acre.

As for EXAMPLE.

	4	40
Acres	*Roods*	*Perches*
120	2	34
275	3	14
162	1	35
98	2	20
47	3	30
64	1	15
769	2	28

Of TIME.

NOTE, That 60 Minutes is 1 Hour, 24 Hours 1 Day and Night, 365 Days 1 Year.

The Year, by the exacteſt Obſervation of the moſt excellent Mathematicians, is found to be 365 Days, 5 Hours, 49 Minutes, 4 Seconds, and 21 Thirds.

So that the Year conſiſteth of 365 Days, and 6 Hours; but the ſix Hours are reckoned every 4th Year, and that Year is called *Leap-Year*, ſo that Year *February* hath 29 Days.

	24	60
Days	*Hours*	*Minutes.*
30	15	40˙
17	10˙	20
10	09	30˙
12	03	30
70	15	00

Note, That in this Rule of *Addition*, for the Help of the Learner, I have pointed over the Head of each Sum, where you are to make a Point; that ſo by ſetting down the Remainder, you carry ſo many Units to your next Rank on the Left-hand, till the Sum is finiſhed: Thus much for *Addition*.

CHAP. II.

SUBTRACTION.

1. S*Ubtraction* teacheth you how to take a Leſſer from a Greater, whereby you may know what remaineth.

2. The Number out of which the Subtraction is to be made, muſt be greater, or at leaſt equal with the other; as you may ſubtract 456 out of 529, but you cannot ſubtract 529 out of 456.

3. In *Subtraction,* rank the two given Numbers one under the other as in *Addition,* with this Caution, that the uppermoſt Number may exceed, or at leaſt be equal unto the other.

4. Let it be required to ſubtract 4786 *l.* out of 5973.

First, I put down the biggeſt Number uppermoſt, *viz.* 5973, and place 4231 under it thus, as you ſee in the Margent. Then I begin at the Right-hand, and ſay 1 out of 3 and there remain 2, which I ſet down in the ſame Rank under the Line. In like Manner, 3 being taken out of 7 there remain 4, which likewiſe I ſet down under the Line in the next Rank: Again, taking 2 out of 9 there remain 7, which I likewiſe place in the third Rank. Laſtly ſubtracting 4 from 5 there will remain 1, which I ſubſcribe under the fourth Rank; ſo the whole Operation being finiſhed, I find that if

5973
4231
―――
1742
―――

4231 be taken out of 5973, the Remainder is 1742, as in the Example,

5973
4231

1742

More Examples of the like Nature as follow,

From	352	769	398	648
Take	121	425	134	426
Remains	231	344	264	222

5. But if the Figure which you are to ſubtract, be greater than the Figure out of which it is to be ſubtracted, then you are to borrow 10, and add it to the uppermoſt Figure, and then ſubtract the ſaid lowermoſt Figure, from their Sum, and place the Remainder underneath the Line; and becauſe you borrowed, add 1 to the next Figure in the lowermoſt Line, and proceed; let this be repeated as often as there is Occaſion.

6. Let it be required to ſubtract 289 out of 478.

From	478
Take	289
Remains	189

I firſt ſet down thoſe two Sums orderly one under the other, always remembring you place the greateſt ſum uppermoſt; and ſay 9 from 8 I cannot, but 9 from 18 reſts 9, which I ſet down under its proper Place; then one I borrowed and 8 makes 9, and 9

9 from 7 I cannot, but 9 from 17 reſts 8, which I ſet down in its proper Place: And laſtly, the one I borrowed and 2 makes 3, and 3 from 4 reſts 1, ſo the Remainder or Difference is found 189.

A few Examples of this Nature will make it underſtood.

A few Examples follow.

From	2510	7121	3975	2641
take	1976	4297	1986	1479
	0534	2824	1989	1162

Note, always, that where you do not borrow, you muſt not carry 1 as in the laſt Example.

For if you do not borrow of any one, you need not pay.

Next in order followeth *Subtraction of Money.*

Subtraction of Money.

IF the given Numbers conſiſt of divers Denominations, ſuch as *Money*, *Weight*, *Meaſure*, *Time*, &c. then you are to place the leſſer Number under the greater in ſuch Sort, that each Denomination may ſtand under its correſpondent Name, as hath been before directed.

Then proceed to ſubtract the undermoſt Line from the uppermoſt, beginning at the leaſt Denomination, and ſo proceed from the Right-hand towards the Left-hand, ſetting the Remainder under the Line till all is finiſhed.

As for EXAMPLE.

Let it be required to ſubtract 90 *l.* 14 *s.* 10 *d.* 3 *far.* from 124 *l.* 11 *s.* 07 *d.* 1 *far.* thus:

	l.	*s.*	*d.*	*f.*
From	124 :	11 :	07 :	1
take	90 :	14 :	10 :	3
Reſt	33 :	16 :	08 :	2

Thus beginning with the Farthings, I ſay 3 Farthings out of 1 I cannot take, wherefore borrowing 1 Penny from the next Denomination, and having converted this 1 Penny into 4 Farthings, I add them to the ſaid 1 Farthing, ſo the Sum is 5 Farthings, out of which ſubtracting 3 Farthings, there remain 2 Farthings, which I place under the Line of Farthings; then I proceed to the next Denomination, and ſay, 1 Penny which I borrowed and ten makes 11, out of 7 *d.* I cannot take, wherefore borrowing 1 Shilling or 12 Pence, and adding it to the 7 Pence, the Sum is 19 Pence, from which taking the ſaid 11 Pence there remains 8 Pence, which I ſet down in its due Place; again 1 Shilling which I borrowed being added to 14 Shillings makes 15 Shillings, which I cannot ſubtract out of 11, and therefore I borrow 1 Pound, which is 20 Shillings, which being added to the aboveſaid 11 Shillings makes 31 Shillings, from which ſubtracting 15 Shillings, there remaineth 16 Shillings, which I place under the Denomination of Shillings, then carrying 1 Pound

l.	*d.*	*s.*	*f.*
124 :	11 :	07 :	1
90 :	14 :	10 :	3
33 :	16 :	08 :	2

1 Pound to the 0 in the Pounds Place maketh 1, which taken out of 4 there remain 3: Again, 9 out of 12 there remain 3, which being placed with its correſpondent Figure 3, ſo that at laſt I find there will remain 33 *l.* 16 *s.* 08 *d.* 2 *f.*

Which is as much as to ſay that if *A* borroweth of *B.* 124 *l.* 11 *s.* 07 *d.* 1 *f.* and *B.* receiveth in Part 90 *l.* 14 *s.* 10 *d.* 3 *f.* there remains due to *B.* 33 *l.* 16 *s.* 08 *d.* 2 *f.*

A few Examples will make this Rule very plain.

	l.	*s.*	*d.*	*f.*	*l.*	*s.*	*d.*	*f.*
Recd	100	10	09	2	5109	13	05	1
Paid	67	14	10	3	3279	10	09	0
Due	32	15	10	3	1830	02	08	1
Proof	100	10	09	2	5109	13	05	1
Debitor	2101	12	07	1	5000	10	00	0
Creditor	1097	15	10	2	3199	14	10	2
Ballance	1003	16	08	3	1800	15	01	2
Proof	2101	12	07	1	5000	10	00	0
Recd	309	00	04	1	1019	12	07	1
Diſburſt	217	19	06	2	796	14	10	0
Reſt	91	00	09	3	222	17	09	1
Proof	309	00	04	1	1019	12	07	1

Note, If a Sum of Money be lent, and Payment thereof made at divers Times, and you would know what is due; in thoſe Caſes, you muſt firſt add up the ſeveral Payments into one Sum, and ſubtract that Sum from the Sum lent, and the Remainder will ſhew what is due. An Example or two will make it eaſy and plain.

	l.	*s.*	*d.*	*l.*	*s.*	*d.*	*far.*
Received	1240	14	07	900	14	07	2
Paid at ſundry Times	300	10	05·	246	17	06	1
	249	16	09	137	15	10·	2·
	450	00	00	256	14	06	0
	100	10	06·	120	00	00	2
	50	00	08	72	13	11·	1
Paid in all	1150	18	04	834	01	10	2
Due	0089	16	03	066	12	09	0
Proof	1240	14	07	900	14	07	2

Received from the Bank——	5240	17	09	0
Paid unto ſeveral Men *per* Order, *viz.*	1000	12	06	0
	500	00	00	0
	329	10	04	2
	715	11	06·	0
	870	05	00	0
	600	00	00	0
	519	10	07	1
	450	00	00	0
Paid in all	4985	09	11	3
Remains	0255	07	09	1
Proof	5240	17	09	0

Troy-Weight.

	℔	12 *oz.*	20 *pwt.*	24 *gr.*	℔	12 *oz.*	20 *pwt.*	24 *gr.*
Bought	354	07	13	15	172	09	14	11
Sold	217	09	05	16	97	06	17	09
Unſold	136	10	07	23	075	02	17	02
Proof	354	07	13	15	172	09	14	11

Another Example of Troy-Weight.

Suppoſe I would ſubtract 17 ℔. 10 *oz.* 11 *pwt.* 20 *gr.* from 24 ℔. 05 *oz.* 00 *pwt.* 8 *gr.* thus place your Numbers;

	℔	12 *oz.*	20 *pwt.*	24 *gr.*
	24	05	00	08
	17	10	11	20
Remains	06	06	08	12

Say 20 from 8 I cannot, but borrow 1 Pennyweight which is 24 Grains, and add them to 8 and they make 32, wherefore I take 20 out of 32 there remains 12; then 1 that I borrow and 11 is 12, from 00 I cannot, but 12 out of 20 there remains 8; then 1 that I borrow and 10 is 11, from 5 I cannot, but 11 from 17 and there remains 06; then 1 that I borrow and 17 is 18, which I take out of 24 there remains 6; ſo that I find the Remainder or Difference to be 6 Pounds, 06 Ounces 08 Penny-weight, and 12 Grains.

℔	*oz.*	*pwt.*	*gr.*
24	05	00	08
17	10	11	20
06	00	08	12
24	05	00	08

Avoirdupois-Weight.

	C.	*qrs.*	℔	*oz.*	C.	*qrs.*	℔.	*oz.*
From	16	2	15	09	32	1	19	10
Take	12	3	12	11	14	2	13	14
Remains	03	3	02	14	17	3	05	12
Proof	16	2	15	09	32	1	19	10

	Tuns	*C.*	*qrs.*	℔.	*C.*	*qrs.*	℔.
Bought	107	10	2	05	74	00	15
Sold	94	17	3	10	19	01	11
Unſold	12	12	2	23	54	03	04
Proof	107	10	2	05	74	00	15

A Merchant ſells ſix Hodgheads of Sugar, *viz.*

Alloweth for Tare, *viz.*

marked	*C.*	*qrs.*	℔.	*C.*	*qrs.*	℔.
A. 1 ——	32	2	19	1	3	11
B. 2 ——	14	0	14	2	0	05
C. 3 ——	17	3	11	2	1	17
D. 4 ——	11	1	07	1	2	08
E. 5 ——	09	2	09	2	1	12
F. 6 ——	15	0	15	1	2	14
Groſs	100	2	19	Tare 11	3	11
Tare	11	3	11			
Neat	88	3	08			

So that the Buyer pays for 88 *C.* 3 *qrs.* and 08 ℔. neat Weight.

* * *

Liquid-Meaſure.

	Tuns	*hdd.*	*gall.*	*Tuns*	*hdd.*	*gall.*	*pints*
Bought	40	1	30	60	3	42	4
Sold	16	1	40	15	3	46	6
Remain	23	3	53	44	3	58	6
Proof	40	1	30	60	3	42	4

Land-

Land-Meaſure.

	Acres	*Roods*	*Perch.*	*A.*	*R.*	*P.*
Bought	780	2	35	2040	1	20
Sold	90	3	36	919	3	30
Reſt	689	2	39	1120	1	30
Proof	780	2	35	2040	1	20

The Proof of *Subtraction* is proved by *Addition*; for if you add the Remainder, and the Number given to be ſubtracted together, the Sum muſt be equal to the Number out of which the Subtraction is made: For if a Servant receives 50 Pound, and he lays out 37 *l.* 14 Shillings and Six-pence, he will have 12 Pounds, 5 Shillings and Six-pence left; for 12 Pounds, 5 Shillings and Six-pence, and 37 Pounds 14 Shillings and Sixpence is 50 Pounds. As in the Margent.

l.	*s.*	*d.*
50	00	00
37	14	06
12	05	06
50	00	00

Queſtions to exerciſe Addition *and* Subtraction.

Queſt. 1. TWO Perſons *A* and *B*, have two Sums of Money; *A* hath 3456 *l.* and *B* 2195 *l.* 17 *s.* 4 *d.* what is the Difference.

3456——
2195 : 17 : 4
1260 : 02 : 8

Anſwer, 1260 *l.* 2 *s.* 8 *d.*

Queſt. 2. Two Perſons are of ſeveral Ages, *A* and *B*, the Age of the Elder being that of *A*, is 65, the Difference of their Ages is 34, what is the Age of B? Anſwer 31.

65
34
———
31

Queſt. 3. What Number is that which being added to 248, maketh the Sum to be 309? Anſwer *61*.

309
248
———
61

Queſt. 4. A certain Perſon born in the Year of our Lord *1660*, how old is he? Anſwer *60*.

1720
1660
———
60

Queſt. 5. A Monument built in the Year 1462. how long is that ſince, reckoning to this preſent Year 1720? Anſwer 258 Years.

1720
1462
———
258

Queſt. 6. The greater of two Numbers 2400, their Difference is 1472, what is the leſſer Number? Anſwer 928.

2400
1472
———
928

CHAP. III.

MULTIPLICATION,

1. *Multiplication* teacheth you how by two or three Numbers given, to find a third or fourth, which ſhall contain either of the given Numbers, as many Times as the other contains 1 or Unit.

2. *Multiplication* begins at the Right-hand, and draweth (that is, multiplieth) every Figure of one Number given, into every Figure of the other Number ſeverally; and at the laſt gathereth together the ſeveral Products into one Sum, having diligent care to place them in their due Places.

3. In *Multiplication* note, the Multiplicand, the Multiplier, and the Product.

4. The Multiplicand is the Number given to be multiplied, and is uſually for Methods Sake, the greateſt of the two given Numbers.

5. The Multiplier is that by which the Multiplicand is multiplied, and is uſually the leaſt Number.

6. The Product is the Number ariſing by the Multiplication, and it containeth the Multiplicand as often as the Multiplier containeth Units.

7. The Work of Multiplication is contained in the following Table, which muſt be learn'd by heart, before the Learner can make any conſiderable Progreſs.

The

The Table of Multiplication *uſually called* Pythagoras's *Table.*

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

7. The Uſe of this Table is thus: Find the two Units given to be multiplied together, one in the upper Column of the Table, and the other in the firſt Column of the Left-hand; This done in the Angle of Poſition, juſt againſt thoſe two Figures, you ſhall find the Product. Thus the Table ſhews you that 5 times *9* is 45, *6* times 7 is 42, 7 times 8 is 5*6*, and *9* times 8 is 72, and ſo of the reſt.

8. Simple *Multiplication* is, when the Multiplicand and Multiplier conſiſt each of them of one only Figure, as in this Example.

As if it were required to multiply 458 by *6*, I ſet them down as followeth:

The

The Multiplicand	458
The Multiplier	6
The Product	2748

Thus I ſay, *6* times 8 is 48, which being 8 above 4 tens, I ſet down 8, and go 4 to the next Place; then I proceed, ſaying, *6* times 5 is 30, and that 4 that I carry is 34, which 4 I ſet down in the Line and carry 3; ſaying [illegible] times 4 is 24, and 3 I carry is 27, I ſet it all down, and ſo the Sum is finiſhed, I find that *6* times 458 is 2748.

Other Examples in this Rule for Practiſe may be ſuch as follow.

Multiplicand	7946	5347	2480	5100
Multiplier	5	6	7	8
Product	39730	32082	17360	40800

Multiplicand	3721	4001	2701	51007
Multiplier	9	4	3	10
Product	33489	16004	8103	510070

Compound Multiplication.

9. *Compound Multiplication* is, when the Multiplicator and Multiplier, either one or both, conſiſt of more Figures than one.

10. When the Product of any of the particular Figures exceeds ten, place the Exceſs under the Line, as before taught; and for every ten that it ſo exceeds,

xceeds, keep it in Mind to be added to the next Rank.

EXAMPLE.

Let it be required to multiply 3084 by 36, the Vork will ſtand thus:

For 6 times 4 is 24 I write 4 under the Line, and reſerve 2 in Mind for the wo Tens; then I ſay, 6 times 8 is 48, nto which if I add 2 kept in Mind, the vhole is 50, wherefore, ſaying, 6 times 0, is nothing, but the 5 I carried in Mind is 5, which is likewiſe ſet under he Line in the next Rank; again, 6 times 3 is 18, vhich I write wholly down, ſo that the particular Product ariſing from the multiplying Figure 6, is 18504. In like Manner proceeding with the multiplying Figure 3, the particular Product ariſing will be 9252. Laſtly, theſe ſeveral Products being placed n due Order, and added together will give 111024, vhich is the total product ariſing from the *Multiplication* of 3084 by 36, as by the Operation above appeareth.

$$\begin{array}{r} 3084 \\ 36 \\ \hline 18504 \\ 9252 \\ \hline 111024 \end{array}$$

In like Manner multiply 52467 by 354.

$$\begin{array}{r} 52467 \\ 354 \\ \hline 209868 \\ 262335 \\ 157401 \\ \hline 18573318 \\ \hline \end{array}$$

Again,

```
Again, multiply      5974623475
               By         67438
                   ------------
                    47796987800
                   17923870425
                  23898493900
                 41822364325
                35847740850
                ---------------
                402916657907050
                ---------------
```

11 When there is one or more Cyphers in th
Multiplier betwixt ſignificant Figures:

1 *As for Example.*

```
   45793              8465008
     507                 4006
 -------           ----------
  320551             50790048
 2289650           3386003200
--------          -----------
23217051          33910822048
--------          -----------
```

When in the Multiplicator Cyphers are include
between ſignificant Figures, multiply by the ſai
ſignificant Figures, neglecting ſuch Cyphers; bu
obſerve diligently to ſet the particular Produc
of the ſignificant Figures in their due Places.

More Examples are theſe that follow.

43100
15000

2155
431

646500000

1	2
8465008	7645932
4006	48000
50790048	61167456
3386003200	30583728
33910822048	367004736000

You may multiply by the ſignificant Figures, as n the ſecond Sum, and afterwards annex as many Cyphers as there are Cyphers in the Multiplier.

Again, multiply 74965
By 1500

374825
74965

112447500

When either the Multiplier or Multiplicand conſiſteth only of an Unit, and one or more Cyphers, annex the Cyphers to the other Number, and the Work is done; as in theſe Examples.

7412	10000	4000
100	425	20
741200	4250000	80000

PROOF.

The Proof of *Multiplication* as is commonly uſed, is by caſting away the 9's out of the Multiplicand, Multiplier, and Product: But this Proof being very erroneous, as is evident to all ſuch as know the Rule, I ſhall therefore forbear ſhewing that Method, by Reaſon, the true Proof of *Multiplication* is by *Diviſion*, and *Diviſion* by *Multiplication*; for as *Multiplication* encreaſeth, ſo *Diviſion* decreaſeth, as hereafter will more fully appear.

Note, That one of the principal Caution's to be obſerved in *Multiplication*, is the due placing of the particular Products, by each multiplying Figure; and that is performed by taking care to place your Figures ſtrait one under another.

CHAP. V.

DIVISION.

1. DIVISION, is that by which we diſcover how often one Number is contained in another.

2. In *Diviſion* there are always three remarkable Numbers, which are commonly called by theſe Names, *viz.*

The *Dividend,*
The *Diviſor,*
And the *Quotient.*

3. The Dividend is the Number given to be divided into equal Parts.

4. The Diviſor is the Number by which the Dividend is to be divided; that is, it is the Number, which ſheweth into how many equal Parts the Dividend muſt be divided.

5. The Quotient is the Number, which diſcovers how often the Diviſor is contained in the Dividend, which is the Number produced by the Diviſion; ſo if 40 were to be given to be divided by 8, the Number produced would be 5.

Dividend
Diviſor 8) 40 (5 Quotient
40
——
0

6. *Diviſion* being the hardeſt Rule in *Arithmetick*, muſt be diligently and carefully minded by the Learner; for whoſe ſake I ſhall uſe the utmoſt of my Judgment, to make the Way ſmooth and eaſy by Rules and Examples, beginning with the eaſieſt firſt, which will be in that Caſe, when the Diviſor conſiſts of one Figure only; as for Example:

Let it be required to divide 88 by 4, firſt write down the Dividend, and then draw a crooked Line, and place the Diviſor on the Left-hand thereof, then draw a Line under the Dividend: Thus,

Dividend
Diviſor 4) 88 (22 Quot.
8..
———
08
8
———
0

7. *Note*, That in every Diviſion you muſt obſerve this Method; Firſt, To aſk how many. Secondly, Multiply. Thirdly, Subſtract.

The Operation of this laſt Sum, I will unfold for the better underſtanding: Thus, having placed a crooked Line at each End of the Dividend, that on the Left-hand for the Diviſor, and that on the Right-hand for the Quotient; then if the Diviſor be a ſingle Figure, ſubſcribe a Point under the firſt Figure of the Dividend towards the Left-hand and a how often the Diviſor 4 is contained in the Dividual 8, the Anſwer is found 2, wherefore I write in the Quotient; then multiplying the Diviſor by 2 (the Number placed in the Quotient) the Product is 8, which I ſubſcribe orderly under the Dividend 8; and after a Line is drawn underneath th Product, I ſubtract it from the Dividend 8, and plac the Remainder 0 underneath the Line. The

Then proceed and put another Point under the next Place of the Dividend towards the Right-hand, and bring down the Figure, or Cypher ſtanding in that Place to the Remainder; that is, ſet it next after it, ſo the whole will be a new Dividual: Thus a Point being place under the other 8, I write down 8 next after 0, to wit, on the Right-hand of the Remainder 0; ſo is 8 a new Dividual or Number, whereof the ſecond Queſtion muſt be asked, and the Work will ſtand thus:

4)88(22
8··
——
08
8
——
0
——

9. A new dividual being brought down which is 8, renew the Queſtion by asking how often 4 is contained in 8, the Anſwer is 2, wherefore I write 2 in the Quotient; then multiplying the Diviſor 4 by 2, the Product is 8, which I ſubſcribe under the Dividual 8; and after a Line is drawn, I ſubtract the Product 8 from the Dividual 8, and there being no Remainder, I ſubſcribe 0 under the Line: So the whole Work is finiſhed, the Quotient is found 23, and the Operation ſtands as you ſee in the Margent; wherefore I ſay, That if 88 Pound were to be divided amongſt 4 Perſons, the Share of each Perſon will be 22 Pounds.

4)88(22
8··
——
08
8
——
0
——

A ſecond EXAMPLE.

Let it be required to divide 7425 amongſt *6* Perſons. Thus,

$6)7425(1237-\frac{3}{6}$

$$\begin{array}{l}
6)7425(1237-\frac{3}{6}\\
\;\;6\cdot\cdot\cdot\cdot\\
\hline
\;\;14\\
\;\;12\\
\hline
\;\;\;22\\
\;\;\;18\\
\hline
\;\;\;\;45\\
\;\;\;\;42\\
\hline
\;\;\;\;\;3\\
\hline
\end{array}$$

This laſt Example by working it according to the laſt Queſtion you will find, that if a Man died worth 7425 Pounds to be diſtributed amongſt *6* Children, their Shares will be found to be 1237 Pounds, and there will be an Overplus of 3 Pounds remaining, which by Reaſon the Remainder 3 is half the Diviſor *6*, it is therefore 10 *s.* more; ſo that every Child muſt have 1237 *l.* 10 *s.* 00 *d.* apiece: But how the before mentioned Fraction 3, or any other Remainder after your Diviſion is finiſhed, will be taught in the next Rule of *Reduction* following.

Various Examples for Practice.

```
8)9640(1205      9)7113(790      3)548(182
  8····            63···           3··
  ———              ———             ———
  16               81              24
  16               81              24
  ———              ———             ———
   040              03              08
    40               0               6
   ———              ———             ———
     0               3               2
   ———              ———             ———
```

Diviſion by two or more Figures the firſt and eaſieſt Method.

10. When the Diviſor conſiſts of two, or three, or how many Places ſoever, the Operation is more difficult than the former, though it depends upon the ſame Grounds; and therefore the Learner being well vers'd in dividing by a ſingle Figure, he will the more readily underſtand theſe that follow, which are two, whereof the firſt is the eaſier, but the latter more expeditious, and that which indeed is principally to be learned: For an Example of the former;

Let it be required to divide 896487 by 648, or which is all one, to divide 896487 into 648 equal Parts.

Firſt a Table is to be made, to ſhew at firſt Sight any Product of the Diviſor, it being taken twice, thrice, or any Number of times under ten, ſo having written down the Diviſor itſelf 648, and drawn a Line on the Right-hand thereof, I place 1 on the Right-hand of the Line directly againſt the Diviſor; then underneath the Diviſor 648, I ſubſcribe the double thereof which is 1296, and place the Figure 2 directly againſt the Diviſor; then underneath

Diviſor	648	1
Multiplees of the Diviſor,	1296	2
	1944	3
	2592	4
	3240	5
	3888	6
	4536	7
	5184	8
	5832	9

the Diviſor 648, I ſubſcribe the Double thereof, which is 1296, and place the Figure 2 directly againſt the ſaid Double on the other Side of the Line: Again, by multiplying the Diviſor 648 by 3, the Sum is 1940, this Triple I ſubſcribe under the Double, and place 3 on the other Side of the Line right againſt the Triple; and ſo proceeding in like Manner with the Quadruple, Quintuple, Sextuple, Septuple, Octuple, and Noncuple of the Diviſor.

648
10
6480

Now for a Proof of the ſaid Table, adding the laſt Number thereof, to wit 5832, which was found to be 9 times the Diviſor to the Diviſor 648, I find the Sum to be 6480, which is ten Times the Diviſor, as you may ſee in the Margent; wherefore I conclude the Table is true, becauſe the laſt Number thereof is derived from all the ſuperior Numbers.

The Table being thus prepared, write down the Dividend, on the Right-hand of the Diviſor; then diſtinguiſh by a Point, ſo many of the foremoſt Places of the Dividend towards the Left-hand, as are either equal in Value to the Diviſor, or which being greater, yet come neareſt to the Value thereof, thus I ſubſcribe a Point under 6, thereby ſetting apart 5976 being the feweſt of the foremoſt Places which will contain the Diviſor 648; ſo is 5976 the Dividual (or Number whereof the firſt Queſtion muſt be asked,) then demanding how often the Diviſor 648

648	
1296	
1944	3
2592	4
3240	5
3888	6
4536	7
5184	8
5832	9

5976472(9222
5832····
1444
1296
1487
1296
1912
1296
616 Rem.

648 is contained in theDividual *5976*, the Anſwer will be found in the Table to be *9* Times; for looking in the Table, I cannot find the Dividual exactly, but I ſee that *9* Times, to wit 5832 is the next Letter, wherefore I write *9* in the Quotient, and the Number in the Table which ſtands againſt *9*, to wit 5832, I ſubſcribe under the Dividual *5976*; then having drawn a Line underneath, I ſubtract 5832 from the Dividual *5976*, and ſubſcribe the Remainder 144 underneath the Line: That done I put a point under the next Place of the Dividend towards the Right-hand, which I find to be 4, I ſubſcribe it after the Remainder 144, ſo there is 1444 for a new Dividend.

Then demanding how often the Diviſor *648* is contained in the Dividual 1444, the Anſwer will be found by the Tables to be 2 times, wherefore I write 2 in the Quotient, and the Number in the Table which ſtands againſt 2, to wit 1*296* I ſubſcribe under, and ſubtract from the Dividual 1444, and there remains 148, which I place underneath the Line.

Again, I put a Point under the next Place of the Dividend, where I find the Figure 7; and therefore tranſcribing 7 next after the Remainder 148, the new Dividual will be 1487; then demanding how often the Diviſor *648* is contained in the Dividual 1487, I find it 2 times contained therein, and wherefore I write 2 in the Quotient, and the Number in the Table is 1*296*, which I ſubſcribe under 1487, and then there will remain 1*9*1, which I place under the Line.

Again, I put a Point under the next Place of the Dividend where I find the Figure 2, and therefore tranſcribing 2 next after the Remainder 1*9*1, the new Dividual will be 1*9*12; then demanding how often the Diviſor *648* is contained in the Dividual 1*9*12, I find it again 2 times, which I write down in the Quotient, *viz.* 1296, which I ſubſcribe under 1912, and then there will remain 616; wherefore I conclude, that if 5976472 be divided by 648, the Quotient will be 9222, and a Remainder of 616, thus commmonly ſet 9222 $\frac{648}{616}$.

In like Manner to divide a greater Number this Way, *viz.* 9120165347 by 2978, the Quotient ariſing will be,

2978	1
5956	2
8934	3
11912	4
14890	5
17868	6
20846	7
23824	8
26802	9

)9120165347(3062513—$\frac{1633}{2978}$.
8934

18616
17868

7485
5956

15293
14890

4034
2978

10567
8934

1633 Remainder.

Proof of the Table.

26802
2978
29780 } is equal to 10 times the Diviſor.

2978
10
29780

The Preceding Method of *Diviſion*, by the Help of Table of the Multiplees, or Product of the Divi- or: As it is moſt eaſy, ſo in ſome Caſes, namely, where the Diviſor is great, and a Quotient of many Places is required; it excels all other Ways of *Divi- ion*, both in Reſpect of Certainty and Expe- ition. But for common Practice it is too te- ious, and therefore I ſhall proceed to the practical Method.

11. I now come to the laſt and principal Method f *Diviſion*, which to ſuch as have the Table of *Mul- iplication* by Heart, it will not be difficult.

Diviſion by two or more Figures, being the ardeſt Leſſon in *Arithmetick*, muſt be carefully minded.

12. When the Diviſor conſiſteth of more Places han one, then you are to ſet out ſo many Figures n the Left-hand of the Dividend for a Dividual, nd then put a Point under that Figure of the Di- idual, which ſtands next to the Right-hand.

Then ſeek how often the firſt Figure towards the Left-hand of the Diviſor, is contained in the firſt Figure towards the Left-hand of the ſaid Dividual, nd place the Anſwer in the Quotient.

Then multiply the whole Diviſor by the ſaid Fi- ure, ſo placed in the Quotient, and place the Pro- uct in order under the Dividend.

Which being done, ſubtract the ſaid Product from he Dividual, placing the Remainder under the Line.

Then put a Point under the next Figure of the Di- idend, and annex it to the Remainder, ſo you have new Dividual, in which you are to proceed as ſhall e directed.

As for EXAMPLE.

Let it be required to divide 8904 by 42, here the given Number being diſpoſed of according as before directed, will ſtand as followeth;

42)8904(

Then becauſe there are 2 Places in the Diviſor, by Conſequence you muſt take the firſt two Figures on the Left-hand of the Dividend for a Dividual which is 89, putting a Point under the 9.

Then I ſeek how often the firſt Figure 4 is contained in the firſt Figure 8, the Anſwer is 2 times, wherefore I multiply 2 in the Quotient by 42, the Diviſor, and the Product is 84, which I tranſcribe directly under 89 and ſubtract it, and there will remain 5.

Then I put a Point under the next Place which is 0, and annex it to the Remainder 5, and it makes 50 for a new Dividual, and the Work will ſtand as followeth:

42)8904(21
84˙˙.
———
50
———

Then I ſeek how often I can have 4 in five, and the Anſwer is 1, wherefore I put 1 in the Quotient, and multiply the Diviſor 42 by 1, which makes 42, which I place under 50, and ſubtract it from 50 and there will remain 8, which I place in order under the Line, and thereto annex the next Figure of the Dividend which is 4, and then it makes 84 for a new Dividual, and then the work will ſtand as followeth:

4

```
42)8904(212
   84··:
   ——
    50
    42
    ——
     84
     84
     ——
      0
     ——
```

Then Laſtly, ſeeking how often 4 is contained in 8, and the Anſwer is 2 times, wherefere I put 2 in the Quotient, and thereby multiply the Diviſor 42 by 2, which makes 84, and by ſubtracting 84 from 84 the Remainder is 0, and ſo the Operation is ended: So that if I divide 8904 Pounds amongſt 42 Perſons, each Perſon muſt have 212 Pounds.

13. *Note*, That whenſoever the Product of the *Multiplication* by the Diviſor, is greater than the Dividual from which it ought to be ſubtracted, ſuch Product muſt be ſtruck out, and a leſſer Figure is to be placed in the Quotient: For you cannot ſubtract a greater Number from a leſſer

A Second EXAMPLE.

Let it be required to divide 8425796 by 365; th work will ſtand thus:

```
365)8425796(23084—136/365.
    730·····
    ----
    1125
    1095
    -----
     3079
     2920
     ----
      1596
      1460
      ----
       136
       ---
```

The Anſwer is 23084—$\frac{136}{065}$. that is to ſay, as 136 is to 365. Which what the Remainder is in Money will be ſhewn to you in the next Rules following.

A third EXAMPLE.

14. Let it be required to divide 4763585 by 587. The Work will ſtand thus:

587)4763585(8115—$\frac{80}{587}$.
4696 · · ·
· 675
587
· 888
587
3015
2935
· · 80 Remainder.

In this Queſtion, becauſe the Diviſor 587 is bigger han the Dividual 476, I therefore put my Point to , then the Dividual becomes 4763, from which taing the Diviſor 587 out of the Dividual, I find it times (for 9 times is too much) ſo placing 8 in the uotient, and having multiplied the Diviſor thereby hich is 4696, and ſubtracting it out of 4763, the emainder is 67, to which by putting a Point to 5; en I have 675 for a new Dividual, and ſo proceedg according as before taught, your Quotient will 8115, and 80 for a Remainder. See the Work.

Fourth

Fourth EXAMPLE.

Let it be required to divide 7910010295 by 59746. Thus,

```
59746) 7910010295 (132393 58117/59746.
       59746······     59746
       ───────         ───────
       193541        • 58117
       179238          794358
       ──────          529572
        143030        926751
        119492       1191537
        ───────      661965
         235382      ──────────
         179238      7910010295
         ───────     ──────────
          561449
          537714
          ───────
           237355
           179238
           ───────
           58117 Remainder.
           ───────
```

15. This latter Method of *Diviſion* is to be pr ferred before any of the common Ways of dividi by daſhing out of Figures, where the Steps of th Diviſion are ſo confounded by a promiſcuous Mu tiplication and Diviſion, that if any Error happens it can ſcarce be corrected without beginning th Work a new: But in this Way before explained, th particular Multiplications, Subtractions and Remai ders, which belong to every Figure of the Quotien are ſo diſtinctly and clearly ſet down, that if an Err happen, it may eaſily be reformed.

In like Manner if you divide 4926735806877 by 846793, the Quotient will be 842639, and the Remainder will be 150, and the Work will ſtand as ere you ſee.

5846793)4926735806877(842639——$\frac{150}{5846793}$
46774344······:

24930140
23387172

15429686
11693586

37361008
35080758

22802507
17540379

52621287
52581137

150 Remainder.

The Proof of this Queſtion is on the other Side.

16. You muſt note, That as many Points as you ave in the Dividend, ſo many Figures you muſt ave in the Quotient: As in this Example you have Points in the Dividend, and you have 6 Figures the Quotient.

17. The Proof of *Multiplication* and *Diviſion*, do terchangeably prove one another; for in *Diviſion*, you multiply the Diviſor by the Quotient, and ld in the Remainders if there be any, the Product ill be equal to the Dividend, as you ſhall find

in this Example of 4926735806877 divided by 5846793.

```
      Diviſor      Dividend     Quotient.  Rem.
Thus  5846793)4926735806877(842639       150
```

PROOF.

```
        5846793
         842639
      ---------
       52621137
      175403790.
     353807585.
    116935861.
    23387172
   46774344
  -------------
  4926735806877
  -------------
```

There is alſo of *Multiplication* and *Diviſion* a common Proof, by caſting out the 9's, but by that Wa of Proof, (though rightly uſed) a falſe Product wi be affirmed to be true, as is manifeſtly known to ſuc as know the Rule, which is mentioned in *Wingate* *Arithmetick*, to ſet a Brand upon it, that it may b avoided by all Lovers of Truth.

And for this Reaſon I have totally avoided th ſhewing of the Method of caſting away the Nines.

Compendiums in Diviſion.

Many Times the Work of *Diviſion* may be muc ſhortned.

1. If the Diviſor has one or more Cyphers on th Right-hand, cut off ſo many Figures on the Righ hand of the Dividend, as there are Cyphers on t Righ

Right-hand of the Diviſor, and divide the remaining Figures of the Dividend, by the remaining Figures of the Diviſor, and to the Remainder annex thoſe Figures cut off from the Dividend, and the Quotient will be 116, and the Remainder 258; as in this Example.

Let it be required to divide 46658 by 400, ſee here the Work.

```
4|00)466|58(116
      4
     ---
     06
      4
     ---
     26
     24
     ---
     258
     ---
```

Divide 4572 by 20, thus

```
457|2
-----  s.
228|12
```

O R

```
                2|0)457|2(228
                    4
                   ---
2|0)279|0           05                2|0)71|5
---------  s         4                --------
   139|10           ---                  35|15
---------           17                --------
                    16
                   ---
                    12 Remainder.
                   ---
```

Again, divide 4720 Pounds amongſt 10 Perſons, the Share of each would be 472 *l.*

1|0)472|0(472

Alſo among 100 Perſons the Share of each would be 47 *l.*

1|00)47|20(47 and a Remainder of 20

Laſtly, If the ſaid 4720 Pounds, were to be divided amongſt 1000 Perſons, the Share of each would be 4 *l.* and a Remainder of 720, to be alſo divided. See the Work as above.

1|000)4|720(4 *l.*

Another EXAMPLE.

Divide 486783 by 15000; firſt I cut off the three Cyphers of the Diviſor, and alſo three Places of the Right of the Dividend, ſo you have 15 for Diviſor, and 486 for my Dividend.

```
15|000)486|793(32
       45..
       ----
        36
        30
       ----
         6 Remainder.
```

For the better underſtanding of theſe Abbreviations by Cyphers, I ſhall inſert ſome more Examples, both mixt and otherwiſe.

Divide 7456787 by 304000, the Quotient will be 24, and there will remain 160787, *viz.* if you cut off 3 Places from the Dividend toward the Right-hand (3 Places, becauſe the Diviſor ends with

3 Cyphers) and then divide 7456 by 304, there will ariſe in the Quotient 24, and the Remainder will be 160, unto which if 787 be annexed, the total Remainder or Surpluſage is 160787, which what it is in Value will appear better in the preceeding Rules. See the Operation.

```
304|000)7456|787(24
        608··
        ----
        1376
        1216
        ----
         160   The Remainder, to which
        ----     adding 787, the total
                 Remainder is 160787, as
                 above taught.
```

Again, Divide 486783 by 15000 thus,

```
15|000)486|793(32
       45··
       --
        36
        30
        --
         6   to which adding 793, it makes
        --     the true Quotient 32-6793/15000.
```

Having thus done, enlarged, and finiſhed the principal Parts of *Arithmetick*, upon the right un-erſtanding whereof, all the following Rules, and all ther Operations whatſoever, wrought by Numbers, o immediately depend; I would therefore adviſe e Learner to be throughly inſtructed before he proeds to the following Chapters.

CHAP. VI.

Of REDUCTION.

1. REDUCTION teacheth you how t bring a greater Number into a leſſe and a leſſer into a greater.

2. *Reduction* is either *deſcending* or aſcending.

3. *Reduction-deſcending* is, when you are to bri Greater into a Leſſer, as Pounds into Shilling Shillings into Pence, Pence into Farthings, and conſequently of all other great Denominations in Leſſer, performed by *Multiplication*.

4. *Reduction-aſcending*. is, when you bring a Leſſ Number into a Greater, as Farthings into Pen Pence into Shillings, Shillings into Pounds, and of the reſt, and this is performed by *Diviſion*.

Of MONEY.

EXAMPLE I.

Deſcending.

1. I Would know how many Farthings there are in 564 Pounds.

```
   564
    20
 ------
 11280 Shillings.
    12
 ------
 22560
 11280
 ------
135360 Pence.
     4
 ------
541440 Farthings.
```

Thus if 564 Pounds be multiplied by 20, the Product is 11280 Shillings, in like Manner 11280 Shillings will be reduced into Pence by 12, and the Product is 135360 Pence, which being multiplied by 4, the Product is 541440 Farthings.

EXAMPLE 2.

Aſcending.

2. In 541440 Farthings how many Pounds.

This Queſtion is the reverſe of the former, and may ſerve for a Proof; by *Diviſion.*

```
          12)     20)
4)541440(135360(1128|0
  4.....   12.....  ————————
  ———      ———
                    564 Pounds.
   14       15      ————————
   12       12
   ———      ———
    21       33
    20       24
    ———      ———
     14       96
     12       96
     ———      ———
      24      00
      24      ———
      ———
      00
      ———
```

Which anſwers directly 564 *l.*

Of bringing Shillings into Pounds, always cut off the laſt Figure an halve it.

```
2|0)1128|0
    ————————
     564
    ————————
```

E

EXAMPLE 3.

l. *s.* *d.* *far.*

3. In 549 : 17 : 6 : 3 how many Farthings.

20

10997 Shillings.

12

22000

10997

131970 Pence

4

527883 Farthings.

Multiply by 20, and take in your 17 Shillings and the Product is 10997, Shillings, which being multiplied by 12 the Product is 131970 Pence by taking in the 6, which Product of Pence being multiplied by 4, and take in your 3 Farthings, the Anſwer is 527883 Farthings.

EXAMPLE 4, *or Proof.*

4. In 527883 Farthings how many Pounds.

12)

4)527883(131970(1099|7

4 12

549—17—6—3 *farth.*

12 119

12 108

07 117

4 108

38 90

36 84

28 6

28

03

Avoirdupois-Weight.

C. qrs. ℔ oz.
Example 1. IN 27 : 2 : 13 : 9 how many Ounces.
4

110 Quarters.
28

883
221

3093 Pounds.
16

18567
3093

49497 Ounces.

Note once for all, That all the Queſtions in *Reduction*, are brought into leſſer or greater Denominations by the Notes in *Addition* afore-recited.

The PROOF.

Example 2. In 49497 Ounces, how many Hundre Weight.

28) 4) C. qrs. ℔. oz.
16)49497(3093(110 (27—2—13—09
48 ⋯ 28⋯ 8⋯

149 29 30
144 28 28
2 Quarters.

57 13 Pounds.
48

9 Ounces.

EX

EXAMPLE 3.

In 795109 Ounces of Pepper, how many Hundred Weight.

```
                  28)    4)    C.  qrs.  ℔   oz.
16)795109(49694(1774(443 : 2 : 22 : 5
   64····  28····  16···
   ---     ---     ---
   155     216     17
   144     196     16
   ---     ---     ---
    111     209    14
     96     196    12
    ---     ---    ---
     150    134    2 Quarters
     144    112    ---
     ---    ---
      69    22 Pounds.
      64    ---
     ---
      5 Ounces.
     ---
```

PROOF.

C. *qrs.* ℔. *oz.*
Example 4. In 443 : 2 : 22 : 5 how many Ounces,
4

1774 Quarters.
28

14194
3550

49694 Pounds.
16

298169
49694

795109 Ounces.

Example 5. In 4 Cheſts of Sugar each weighing 7 *C.* 3 *qrs.* 12 ℔. Groſs, how many ℔ Neat.

C. *qrs.* ℔.
7 : 3 : 12
4

31
28

250
63

880 Pounds.
4 Cheſts.

3520 Pounds in all.

PROOF

PROOF.

```
         28) 4) C .qrs.  ℔.
4)3520(880(31(7 : 3 : 12
  32···  84··  28
  ————  ——-  ——-
   32    40   3 Quarters.
   32    28
  ————  ——-
   00    12 Pounds.
  ————
```

I do not queſtion but by the Underſtanding of the egoing Examples, the Learner is ſufficiently in- ucted in the proving of any Sum in *Reduction*. My ſign being not to trouble myſelf any more with Proofs; but the rather to go forward with Mat- s more uſeful, and ſo I ſhall proceed with ſome amples of *Tret* and *Tare*, *Cloth-Meaſure*, and o- r Examples in order.

Of Tret and Tare.

te, GROSS is the Weight of any Commodity, with the Hogſheads, Casks, Cheſts, whatſoever elſe contains the Commodity.

Tret is an Allowance of 4 Pounds in the 104 unds, allowed by the Merchants of *London*, for ſte and Duſt on ſome Sort of Goods.

Tare is the Allowance given for the Weight of Cask, Hogſhead, Rapper, *&c.*

'As for EXAMPLE.

Queſt. In 48 : 3 : 14 Tare, 3 : 3 : 17 how man Pounds Neat.

```
C.  qrs  ℔
48 : 3 : 14 Groſs.
 3 : 3 : 00 Tare deducted.
——————————————
45 : 0 : 14 Remains.
 4
————
180 Quarters
 28
1444
361
————
5054 Pounds neat.
————
```

```
          C.  qrs.  ℔.
112)5054(45 : 0 : 14 Neat.
    448..
    ————
     574
     560
    ————
      14
    ————
```

Which Pounds neat being divided by 112 gi you 45 : 0 : 14 Neat Weight.

C. *qrs.* ℔. ℔.
Queſt. 2 In 145 : 2 : 16 Tare 14 *per* Hundred, Tret 4 Pounds *per* 104, how many Pounds neat.

C. *qrs.* ℔.	C. *qrs.* ℔.
145 : 2 : 16	145 : 2 : 16
4	14
582 Quarters	580
28	145
4662	2030
1165	9 Allowed for the 2 Quart. and 16 ℔.
16312 ℔ Subtle.	2039
2039 ℔ Tare.	
14273 Remainder.	
627 ℔ Tret	26)16312(627 ℔ Tr
	156
13646 ℔ Neat.	
	71
	52
	192
	182
	10

OR the Pounds Neat being ivided by 112 makes 121 C. qrs. 10 ℔. Neat Weight.

C. *qrs.* ℔.
112)13646(121 : 3 : 10
112
244
224
206
112
94 C. 3 *qrs.* 10 ℔

I divide the Pounds y Subtle by 26, becauſe ℔ is the 26th of 104, he Allowance always ven for Tret.)

. *qrs.* ℔.
is equal to 3 : 10

Queſt. 3. In 3 Bags of Pepper weighing Groſs 34 C. 3 *qrs*, 16 ℔. Tare 12 ℔. *per* Bag, and Tret 4 ℔. *per* 104, how many Hundred Weight Neat.

C. *qrs.* ℔. *t.*
34 : 3 : 16 12
4 3 tare

139 36 *p.* ba
28

1118
279

3908 ℔ Subtle.
36 ℔ Tare. *p.* Bag.
℔ tre
3872 ℔ Groſs. 26)3872 (14
148 Tret. 26··

3724 —Neat. 127
104

232
208

24

C. *qrs.* ℔.
Or 112)3724(33 : 1 : 0 Neat.
336··

364
336

28

C. *qrs.* ℔.
Anſwer 33 : 1 : 00 Neat.

*

Troy-Weight.

℔. *oz.* *pwt.* *gr.*
Queſt. 1. IN 57 : 09 : 13 : 15 how many Grains.
12

123
57

693 Ounces
20

13860 Pennywt.
24

55440
27720

332640 Grains.

Queſt. 2. In 297456 Grains, how many Grains Goldſmiths Weight.

```
                     20)  12)  ℔   oz. pwt. gr.
24)297456(12394(619(51 : 7 : 4 : 0
   24····   120··· 60
   ----     ----   ----
    57       39     19
    48       20     12
    ----     ----   ----
     94      194     7
     72      180    ----
     ----    ----
     225       4 Pennywt.
     216     ----
     ----
       96
       96
      ----
        0
      ----
```

Anſwer, 51 Pounds, 7 Ounces, 4 Penny-weigh
0 Grains.

Liquid-Meaſure.

Tuns hh. gall.
Queſt. 1. IN 72 : 2 : 25 how many Quarts of Wine.
4

290 Hogſheads.
63

875
1742

18295 Gallons.
4

73180 Quarts.

Tuns hhds. gall. Pott. Quart.
Queſt. 2. In 24 : 3 : 20 : 1 : 1 how many Pints.
4

99 Hogſheads.
63

297
596

6257 Gallons.
2

12515 Pottles.
2

25031 Quarts.
2

50062 Pints. Anſwer, 50062 Pints.

Thus

Thus 50062 Pint-Bottles, or 25031, Quart-Bottles of Wine may be filled out of the Quantity o Wine afore-recited.

* * *

Dry-Meaſure.

EXAMPLE.

Laſt. Qu. Buſh. Gall.
Queſt. 1. IN 46 : 5 : 3 : 2 how many Buſhels o
(Whea
10

465 Quarters.
8

3723 Buſhels of Wheat.

Anſwer 2723 Buſhels of Whe

* * *

Cloth-Meaſure.

Ells Eng. qrs. nail.
Queſt. 1. In 546 : 3 : 2 how many Nails.
5

2733 Quarters.
4

10934 Nails.

Anſwer, 10934 Nails.

Queſ

Yards qrs. nail.
Queſt. 2. In 642 : 2 : 3 how many Nails.
4

2570 Quarters.
4

10283 Nails.

Anſwer, 10283 Nails.

Ells Flem. qrs. nail.
Queſt. 3; In 9176 : 2 : 2 how many Yards.
3

27530 Quarters.
4

110122 Nails.

4 *Yards qrs. nail.*
4) 110122 (27530 (6882 : 2 : 2
8···· 24

30 35
28 32

21 33
20 32

12 10
12 8

02 2

Queſt. 4. In 245 Yards, how many Ells *Engliſh.*

4

980 Quarters. 5)980(196 Ells *Eng*

5...

48

45

30

30

0

Queſt. 5. In 196 Ells *Engliſh,* how many Yards.

5

980 Quarters. 4)980(245 Yard

8...

18

16

20

20

0

Queſt. 6. In 245 Ells *Flemiſh,* how many Ells *E*

3 5)735(147 Ells *E*

5...

735 Quarters.

23

20

35

35

0

Long-Meaſure.

Queſt. 1. THE Circumference of the Earth being 360 Degrees, and every Degree 60 *Engliſh* Miles, how many Miles, Furlongs, Perches, Inches, and Barley-corns will reach round the World.

360 Degrees.
60 Miles to a Degree.

21600 Miles about the Earth.
8 Furlongs.

172800 Furlongs about the Earth.
40 Perches in a Mile.

6912000 Perches about the Earth.
33 Half Feet in a Perch.

20736000
20736000

228096000 Half Feet about the Earth.
6 Inches in a half Foot.

1368576000 Inches.
3 Barley-corns in an Inch.

4105728000 Barley-corns about the Earth.

Again, *Queſt.* 2. In 64827777 Feet, how many Miles.

```
                 1760
   3)64827777(21609259(12277 Miles.
     6·······   1760·····
     ----       -----
     04          4009
     3           3520
     ----       -----
      18         4892
      18         3520
     ----       -----
      027        13725
       27        12320
       ----      -----
        07       14059
         6       12320
       ----      -----
         17       1739 Yards.
         15      -----
        ----
          27
          27
        ----
           0 Inch.
        ----
```

Three Feet 1 Yard, 1760 Yards makes a Mile.

Queſt. 3. How many Barley-corns will reach from *ndon* to *York*, accounting it 150 Miles thither.

150
8

1200 Furlongs.
40

48000 Perches
33

144000
144000

1584000 half Feet.
6

9504000 Inches.
3

28512000 Barley-corns.

Anſwer, 28512000 Barley-corns.

Land-

Land-Meaſure.

Of ſuperficial Meaſures of Land.

Queſt. 1. IN 225 Acres, 3 Roods, and 30 Perches, how many Perches.

225 Acres.
4

903 Roods.
40

36150 Perches for Anſwer.

Queſt. 2. In 560 Acres, how many Perches.

560 Acres.
4

2240 Roods.
40

89600 Perches.

Anſwer, 89600 Perches.

Of TIME.

Queſt. I would know how many Days, Hours, and Minutes it is ſince the Birth of our Saviour *Jeſus Chriſt*, to this preſent Year 1720.

1720 Years.
365 Days in a Year.

8600
10320
5160

627800 Days ſince the Birth of Chriſt.
24 Hours in one Day.

2511200
1255600

15067200
10320 Hours added.

15077520 Hours ſince the Birth of Chriſt.
60 Minutes in an Hour.

904651200 Minutes in all.

1720
6

10320 Hours to be added.

Anſwer, 904651200 Minutes ſince our Saviour *Jeſus Chriſt* was born.

Note, The Reaſon why the Hours are added, is, becauſe that there are in every Year 365 Days and 6 Hours; therefore in 1720 Years, there have paſſed 10320 Hours.

Queſt. 2. A Lady born in the Year 1662, would know how many Years, Hours, and Minutes ſhe hath lived.

1720
1662
58 Years ſhe hath lived.

365 Days.
58 Years.

2920
1825

21170 Days ſhe hath lived.
24

84680 58
42340 6

508080 348 Hours
348 Hours added. (added.

508428 Hours the Lady hath liv'd
60

30503680 Minutes.

Anſwer, The Lady hath lived thirty millions five hundred, three thouſand, ſix hundred and eighty Minutes.

Redu-

Reduction of Foreign Coins into our Engliſh *Money, as alſo foreign* Money *into* Engliſh, *commonly called* Reduction of Coins.

The RULE.

LET your ſecond and third Numbers be both of one Denomination; then multiply your ſecond under your firſt, and the Quotient is your Anſwer.

As for EXAMPLE.

Queſt. 1. In 529*l.* Sterl. at $\overset{s.}{20}$ *per l.* how many Livres at 20 *d. per* Livre.

Livres	*s.*	*d.*
259	20	20
240	12	
21160	240	
1058		
126960		

20)126960(6348 Livres.
120
69
60
96
80
160
160
0

Anſwer 6348 Livres.

Queſt. 2. In 6348 Livres at 20 *d.* how many Pound
Sterling, at 20 *s. per* l.

s. *d.*
6348——20——20
20 12
126960 240

240)126960(529 Pounds Sterl.
1200
696
480
2160
2160
0

This Queſtion is the reverſe of the laſt.

Que

Queſt. 3. In 7249 *Flemiſh* Pounds at 35 *s.* 6 *d.* how any Guineas at 21 *s.*

```
                 s.    d.     s.
    7249———————35  :  6———————21
     426         12            12
    —————      —————        —————
   43494         76           252
   14498         35         —————
  28996        —————
 ———————        426
 3088074       —————
 ———————
```

```
                Guineas.
252)3088074(12254——66/252.
    252
   —————
     568
     504
    —————
      640
      504
     —————
      1367
      1260
     —————
       1074
       1008
      —————
         66
      —————
```

Anſwer, 12254 - $\frac{66}{252}$. Guineas at *London.*

Queſt. 4 In 6340 *Flemiſh* Ducatoons at 5 *s.* 4 *per* Ducatoon, how many Pounds Sterling, at 20 *per* Pound.

Ducatoons *s.* *d.* *s.*
6340——5 : 4——20
64 12 12
25360 64 240
38040
405760

240)405760(1690—$\frac{160}{240}$.
240
1657
1440
2176
2160
160

Anſwer, He muſt receive in *London* 1690— Pounds Sterling, for his *Flemiſh* Ducatoons.

Queſt. 5. In 905 Guineas at 21 *s.* 6 *d.* *per* Guinea; ow many *French* Piſtols at 17 *s.* 6 *d.*

```
 Guineas        s.   d.        s.   d.
    905——————21 : 6————————17 : 6
    258—————   12              12
   ————       ————          ————
   7240        48              40
  4525         21              17
 1810         ————          ————
—————————      258             210
 233490       ————          ————
—————————

                                Piſtols.
           210)233490(1111—180/120.
               210
               ————
                234
                210
                ————
                 249
                 210
                 ————
                  390
                  210
                  ————
                   180
```

Anſwer, he muſt receive in *France* 1111—$\frac{180}{210}$ Pi
ls.

CHAP. VII.

The Rule of Three direct or the Golden Rule.

THIS Rule is ſo called, from its excellen Uſe in Numbers; whereby three Numbers known or given, to find a fourth unknown. It is called *The Rule of Proportio* for the Reaſon hereafter declared.

2. Take care in the ſtating of your Queſtio That you always make your firſt and third Numbe of one Denomination, and the ſecond Place bei the Suppoſition, muſt after Operation be found the ſame Degree with your fourth Number ſought

3. But for the better underſtanding of the Ru by which this *Rule of Three direct* is worked, let th Direction be well obſerved and learn'd, if not learn by Heart, and the Learner will find the Benef *viz.*

The R U L E.

4. In this Rule you muſt make your firſt and thi Numbers both of one Kind. Then go unto yo ſecond, or middle Number, and reduce that into t loweſt Value there named; then multiply your ſecond Number under your third, making that Nu ber your Dividend, and divide by your firſt Nu ber, and the Quotient of your *Diviſion* anſwers t Queſtion demanded, and is always of the ſame D nominati

omination with your ſecond Number, whether
ounds, Shillings, Pence or Farthings, or any other
ame or kind whatſoever; which if it ſhall happen
o be of any great Number, whether of Weights,
eaſure, or Time, you may reduce them into its
weſt Value, by the Rules of *Reduction* before
ught.

As for EXAMPLE.

If 4 Days ſpend 12 *s.* what will 365 Days?

```
                                 12
4)4380(109|5                   ------
  4....   --|--                 730
------    54|15                 365
  038     -----                ------
  36                            4380
------                         ------
   20
   20
------
    0
------
```

l. *s.* *d.*
Anſwer, 54 : 15 : 00

Thus, as you ſee the Rule directs, by multiply-
g your ſecond Number under your third, the Pro-
ct is 4380, which dividing by your firſt Number
the Quotient is 1095 Shillings, which is turned
o Pounds by cutting off the laſt Figure, and hal-
g the Number as you find above, which makes
l. 15 *s.* 00 *d.*

Another Queſtion much after the ſame Reaſon,
y ſerve for a ſecond Example.

EXAMPLE 2.

If 7 Days expend 2 *l.* 17 *s.* 9 *d.* 2 *f.* what wi
148 Days.

```
               20
             ------
               57
               12
             ------
              123
               57
             ------
              693
                4
             2774
              148
             --------
            20192
           11096
          2774
          ---------  4)      12)
       7)408552 (58364)14591(121|5
         35....    4....  12...    -------
         ---      ---    ---       60|15:
          58       18     25
          56       16     24
         ---      ---    ---
           25       23     19
           21       20     12
          ---      ---    ---
           45       36     71
           42       36     60
          ---      ---    ---
            32      04     11
            28       4    ---
           ---     ---
             4       0
```

Anſwer, 60 *l.* 15 *s.* 11 *d.* 0 *far.* $\frac{4}{7}$.

The Explication of the laſt Example, you may bſerve, is performed (as by the Rule it appeareth) y bringing your ſecond Number into the loweſt alue there named, which is Farthings, and ſo ultiplying your third Number under your ſecond, ur Product is 408552; which being divided by ur firſt Number 7, the Quotient is 58364; which Reaſon your middle Number is Farthings, the uotient is 58364 Farthings; which being reduced to Pounds, Shillings, Pence and Farthings, maketh e Product, as before, 60 Pounds, 15 Shillings, Pence, 0 Farthings, and $\frac{4}{7}$ of a Farthing.

A third EXAMPLE.

If 1 *C.* Weight of Tobacco coſt 4 *l.* 5 *s.* 2 *d*, what ll 34 *C.* 3 *qrs.* 18 ℔. coſt at that Rate.

In this Example, becauſe the third Number menns Pounds, therefore the firſt and third Numbers ſt be brought into Pounds, and the ſecond Numr into Pence, and then the ſecond Number being ltiplied by the third, the Product is Pence; which ng reduced maketh 148 *l.* 13 *s.* 02 *d.* and 84 Reineth, and what the Remainder maketh, ſhall be ght as we learn farther. See the Work.

EXAMPLE 3.

```
 lb.          l.  s.  d.        C.  qrs. lb.
 112 ———————— 4 : 5 : 2 ——————— 34 : 3 : 18
             20                  4
             ——                 ———
             85                 139
             12                  28
             ———                ————
             172                1120
             85                 279
             ———                ————
             1022               3910
             ————               1022
                              ———————
                                7820
                               7820
                             9100
                             ———————
                             3996020

                      12
     112)3996020(35678(297|3
         336....  24....  ———————
         ———      ———     148|13 : 2 84/112
          636     116
          560     108
          ———     ———
           760     87
           672     84
           ———     ——
            882     38
            784     36
            ———     ——
             980     2
             896
             ———
              84
```

Anſwer, 148 *l.* 13 *s.* 2 *d.* $\frac{84}{112}$ $\frac{3}{4}$.

EXAMPLE 4.

If 1 Year have 3756 *l.* 14 *s.* 9 *d.* what is 1 Day.

Days *l.* *s.* *d.* *Day*
365——3756 : 14 : 9——1
20
75134
12
150277
75134
12)
365)901617(2470(20|5
730 24 *d.*
10|5 : 10 $\frac{067}{365}$.
1716 070
1460 60
2561 10
2555
67

l. *s.* *d.*
Anſwer, 10 : 5 : 10—$\frac{067}{365}$.

Example the 5th, or the Proof of the laſt Queſtion.

```
    Day         l.    s.     d.                    Days
If  1 ſpend    10  :  5  :  10—067/365. what will  365
               20
              ----
              205
               12
              ----
              420
             206
            -----
             2470
             365
            ------
            12357
           14826
           7410
          --------
      12)901617(7513|4
         84····   -------
         ----     3756 l. 14 s. 9 d. for Anſwer,
          61
          60
         ---
           16
           12
           ---
            41
            36
            ---
            57
            48
            ---
             9
            ---
```

In multiplying 365 under 2470, there is taken in th Remainder 67, as by the Operation.

EXAMPLE 6.

C. qrs. ℔. *d.*
What comes 14 : 2 : 13 of Sugar to at 4 ½ *p.* Pound.

℔ *Sugar* *d.* *C. qrs.* ℔.
1 ——— 4 ½ ——— 14 : 2 : 13

4 4
18 58
28
467
117
1637
18
13096
1637
29466

12
4)29466)7366(61|3
28 72
30|13 : 10 : ½.
14 16
12 12
26 46
24 36
26 10
24
2

Anſwer, 30 *l.* 13 *s.* 10 *d.* ½.

Obſerve, When the firſt Number is 1 or Unity, then e Product of your third Number is of the ſame enomination as you left your ſecond Number in; in this Example 'tis Farthings, therefore 29466 is rthings.

E X-

EXAMPLE 7.

If 1 Ounce of Silver coſt 5 *s.* 3 *d.* what will 46 Ounces, 13 Pennyweight and 12 Grains Coſt.

```
 oz.            s.  d.          oz.  pwt. grains.
  1 ————————————5 : 4———————————46 : 13 : 12
 20            12               20
————          ————             ————
 20            64              933
 24                             24
————                           ————
 80                           3734
40                            1867
————                          ————
480                          22404
————                            64
                             —————
                             89616
                            134424
                            ———————
                            1433856

                 12
480) 1433856(2987(24|8
      960˙˙˙  24˙˙˙ ————
     ————    ————  12 : 8 : 11.—096/480.
      4738     58
      4320     48
     ————    ————
      4185    107
      3840     96
     ————    ————
       3456    11
       3360  ————
      ————
        96
      ————
```

Anſwer, 12 *l.* 8 *s.* 11—$\frac{096}{480}$.

E X

EXAMPLE 8.

If a Piece of Scarlet coſts 189 *l.* 19 *s.* and a Yard is ld for 3 *l.* 15 *s.* 8 *d.* how many Yards were in the iece. Stated thus:

```
l.   s.   d.                              l.    s.
3 : 15 : 8 buy 1 Yard——what will 189 : 19
20                                         20
75                                       3799
12                                         12
158                                      7598
75                                      3799
908                                     45588
```

Yards.

$908)45588(50—\frac{188}{908}$.

4540

188

Anſwer, 50 Yards—$\frac{188}{908}$ Parts.

EX-

EXAMPLE. 9.

What will the Intereſt of 876 *l.* 17 *s.* 6 *d.* amount unto for 1 Year, at the Rate of 6 *l.* for every 100 *l.* for the ſame Time. Thus,

```
  l.                  l.                          l.  s. d.
If 100 principal gain 6 Intereſt,  what will :876-16-6
   20                 20                            20
 ------             ------                       -------
  2000               120                          17536
    12                12                             12
 ------             ------                       -------
 24000              1440                          35078
 ------             ------                       17536
                                                 -------
                                                 210438
                                                   1440
                                                 -------
                     12)
24|000)303030|720(12626(105|2                    8417520
         24....     12....  -----               841752
        ----        ----    52|12:2             210438
          63          62                        --------
          48          60                        303030720
        ----         ----                       ---------
          150         26
          144         24
         -----       ----
            63         2
            48
          ----
           150
           144
          ----
             6
          ----
```

Anſwer, 52 *l.* 12 *s.* 2 *d.* $\frac{06}{24}$ $\frac{1}{4}$.

E X A M P L E. 10.

At 15 *d.* ½ *p.* ℔. how many hundred Weight or 11 *l.* 11 *s.* 11 *d.*

```
 d.      ℔                          l.   s.   d.
If 15 ½ Buy 1 ——— how many for 11 : 11 : 11
   4                                20
  ———                              ———
  62                               231
  ———                               12
                                   ———
                                   463
                                   232
                                   ————
                                   2783
                                      4
                                   ————
                                   11132
          28  4 C. qrs. ℔.        ——————
62)11132(179(6(1 : 2 : 11—34/62 17/31.
   62···  168 4
   ———   ——— ——
   493    11  2
   434   [——  ——
   ———
    592
    558
    ———
     34       Anſwer 1 C. 2 qrs. 11 ℔. 17/31.
```

Let the Learner obſerve once for all in the Proſecution of his Examples, the right ſtating of his Queſtion; for if Weight, Meaſure or Intereſt-Money be demanded, or whatever it is, you muſt always place our Demand in the ſecond Place, and your Quoient anſwers to that Denomination. See your Rule.

Thus having demonſtrated the Reaſon of th Rule in the ten foregoing Examples, I ſhall procee now to propoſe ſeveral Queſtions in this for th Learner's Practice, and only ſet down their *Faci* as a further Help.

Queſt. 1. What is the Price of a Pint of Oil, whe a Tun coſts 35 *l.* 12 *s.* 9 *d.*

4 *hogſheads* a Tun Anſwer, 4 *d.*—$\frac{163}{672}$.

Queſt. 2. What is the Value of a Pound of Indico when a Tun coſts 1000 *l.*

20 *C.* 1 Tun. Anſwer, 8 *s.* 11 *d.* $\frac{1}{7}$.

Queſt. 3. Bought three Hogſheads of Nutmegs a 5 *s.* 7 *d.* the Ounce, weighing in all 12 *C.* 2 *qrs.* 25 ℔

Anſwer, 6365 *l.*

Queſt. What may be ſpent a Day out of an Eſta of 3050 *per Annum*, there being a Reſervation o *viz.*

l.
300 for Taxes. *l.*
005 for pious Uſes, and 3050
200 for Annuities. 505

505 2545 clear Eſt

365——————2545——————1

Anſwer, 6 *l.* 19 *s.* 5 *d.*

Queſt. 5. A Gentleman expendeth daily one Day ith another 27 *s.* 10 *d.* $\frac{1}{2}$. and at the Year's End yeth up 340 *l.* what is his yearly Income thus:

Day *s.* *d.* *Days* *l.* *s.* *d.*
1——27 : 10 : $\frac{1}{2}$——365 Anſw. 508 : 14 : 4$\frac{1}{2}$
add 340 : 00 : 0

Anſwer, 848 *l.* 14 *s.* 4 *d.* $\frac{1}{2}$. 848 : 14 : 4$\frac{1}{2}$

Queſt. 6. If 100 ℔. of Cloves coſt 89 *l.* 11 *s.* 10 *d.* d 112 ℔. of Mace for 96 *l.* 10 *s.* 2 *d,* what coſt Ounces one with another.

l.		*l.*	*s.*	*d.*
100	add	89	11	10
112		96	10	02
212		186	02	00

℔. *l.* *s.* *d.* *oz.*
212——186 : 02 : 00——3

Anſwer, 3 *s.* 3 *d.* $\frac{1704}{3392}$.

Queſt. 7. If a Pennyweight of Gold be worth *s.* 6 *d.* $\frac{1}{2}$ what is a Pound of that Gold worth?

Anſwer, 42 *l.* 10 *s.* 0 *d.* $\frac{1}{2}$.

Queſt. 8. What Part of Time does anſwer to Degrees of the Equinoctial.

deg. *hours* *deg.*
360——24——15 Anſwer, 1 Hour.

So that every Hour Anſwers 15 Degrees in the n's Diurnal Motion.

Queſt. 9. A Gentleman hath owing him 357 *l*. 9 and his Debtor doth agree with him to pay 13 *s*. 5 for every 20 *s*. what ready Money muſt he pay him.

Anſwer, 239 *l*. 15 *s*. 9 *d*. $\frac{1}{4}$.

Queſt. 10. A Goldſmith buys an Ounce of ol wrought Silver for 5 *s*. *per* Ounce, what is the Pric of 14 Ingots of Silver, each Ingot weighing 7 ℔ 5 o 10 *pwt*.

Anſwer, 313 *l*. 05 *s*. 0 *d*.

Queſt. 11. If a Wedge of Gold weighing 17 *l*. *Troy-weight* be worth 679 *l*. 12 *s*. 06 *d*. what is a Grai of that Gold worth?

Anſwer, 1 *d*. $\frac{1}{2}$ $\frac{1623}{2448}$.

Queſt. 12. What Principal in 12 Months Tim will gain 64 *l*. 10 *s*. at the Rate of 6 *l*. *per Cent*.

Int. *Principal* *l*. *s*. *Int*.
6——100——64 : 10

Anſwer, 1075 *l*.

Queſt. 13. If Coffee be ſold for 7 *s*. 6 *d*. a Poun what is 1 Ounce worth?

Anſwer, 5 *d*. $\frac{1}{2}$ $\frac{08}{16}$ *half Fart*

Queſt. 14. A Butcher bought an Ox (weighin beſides Skin and Legs) 898 Pounds, the Ox co him 12 *l*. he ſold the Skin and Legs for 22 *s*. 4 *d*. an 16 ℔. $\frac{1}{4}$ Stone of Tallow at 5 *d*. $\frac{1}{2}$ *per* Pound, wh doth a Stone of Beef ſtand him in at 8 ℔ a Ston and how muſt he ſell a Stone to gain 40 *s*. in th whole Ox.

Sto

Thus,

tone *d.* *l.* *s.* *d.*

$16\frac{1}{4}$ at $5\frac{1}{2}$ comes to 2 : 19 : 7 the Tallow.

1 : 02 : 4 Skin and Legs.

4 : 01 : 11

12 : 00 : 00

4 : 01 : 11 ſubtract.

7 : 18 : 01 Reſt.

℔ *l.* *s.* *d.* ℔.

8*9*8———7 : 18 : 01———8

Anſwer 16 *d.* $\frac{3}{4}$ prime Coſt.

Then for him to gain 2 *l.* add it to the prime oſt, and then it becomes 9 *l.* 18 *s.* 01 *d.*

℔ *l.* *s.* *d.* 8

8*9*8———9 : 18 : 01———8

Anſwer, 21 *l.* he ſells it for to gain 40 *s.*

Queſt. 15. Sold 45 *C.* 3 *qrs.* 15 *l.* of Raiſins, Tare 16 ℔. *per.* every hundred Weight, Tret 4 *l. per* 104, at 3 *d.* ¾ *per* ℔ Neat what do the Raiſins amount unto.

C. *qrs.* ℔.	*C.* *qrs.* ℔.
45 : 3 : 15	45 : 3 : 15
4	16 Tare.
183 Quarters.	270
28	45
1469	720
367	14 allowed for 3 *qrs.* 15 ℔
5139 ℔ Groſs.	734 ℔ Tare.
734 Tare.	
4405 ℔ Subtle.	26)4405(169 Tret.
169 ℔ Tare.	26
4236 ℔ Neat.	180
	156
	245
	234
	11

Then place it in your Rule.

l. — *d.* — *l.*

If 1 —— 3 ¾ —— 4236

Anſwer, 66 *l.* 3 *s.* 9 *d.*

Queſt. 16. In 76 Hogſheads of Tobacco weighing ach 3 *C.* 2 *qrs.* 17 ℔. Tare, 12 *l. per* Hundred and *l. per* Hogſheads, Tret 4 *l. per* 104 at 2 *d.* $\frac{1}{2}$ *per* ℔ Neat, how much Money doth it amount unto. Thus:

C. qrs. ℔.		C. *qrs.* ℔.
3 : 2 : 17	112)31084(	277 : 2 : 4
4	224	12
14	868	554
28	784	277
119	844	3324
29	784	6
409 ℔ in 1 Hogſhead.	60	3330 ℔ Tare *p.C.*
76		
454	76	
63	6	
084 ℔ in all.	456 Tare *per* Hogſheads	
330 Tare *per* Hundred.		
754 Remainder.	26)27298(1049 ℔ Tret.	
456 Tare *per* Hogſh.	26	
298 ℔ Subtle.	129	
049 Tret.	104	
249 ℔ Neat.	258	
	234	
	24	

Then place in your Rule.

l.——2 *d* $\frac{1}{2}$. what 26249 *l.* —— of Tobacco.
ur Anſwer will be 273 *l.* 8 *s.* 6 *d.* $\frac{1}{2}$.

*Queſt.*17. If *Exeter* be diſtant from *London* 140 Miles, and that at the ſame Time one Footman, *viz.* *A*, departed from *London* towards *Exeter*, travelling every Day 8 Miles. The other Footman *B* comes from *Exeter* towards *London*, and he travelleth every Day 6 Miles; the Queſtion is to know how many Days it will be before they meet one another, as alſo to know how many Miles each Footman will have then travelled.

Anſwer, They will meet at the End of 10 Days, and then *A* will have travelled 80 Miles and *B* 60.

Thus found.

$$\text{add}\begin{cases}8 \text{ Miles travelled by } A \text{ daily.}\\ 6 \text{ Miles travelled by } B \text{ daily.}\end{cases}$$

14

14 Miles which *A* and *B* together did travel.

Then,

Miles *Days* *Miles* *Days*

14)140(10 If 14——1——140(10

In which Time *A* and *B* meet.

Therefore 10 multiplied by 8 makes 80 *A*:

10 multiplied by 6 makes 60 *B*. acco

to the Queſtion:

The Proof of the Rule of Three direct.

For the Proof of *The Rule of Three direct*, y muſt multiply the fourth Term (or Anſwer to t Queſtion) by the firſt, and if the Product there be equal to the Product of the ſecond and third, then is the Operation truly performed. But if it happen that after the fourth Term, you ſhall find in the Diviſion a Remainder, ſuch Remainder muſt be added to the Product of the firſt Term. So in the fourth Example in this Rule.

Days	*Pence*	*Day*	*Pence*
365———	901617———	1	Anſwer $2470\frac{67}{365}$.

So in this Example, the fourth Term is 2470, nd there happens to be a Remainder of 67, which eing added to the Multiplication of the ſaid 2470, nakes it equal to the Product of the ſecond and hird.

Thus:

2470 Firſt and Fourth with the Remainder 67,
365 is equal to the firſt and Fourth.

12350
14820
7410

901550
67 added.

901617 Product.

901617 ſecond Term.
1 third Term.

901617 Product.

This is the common Proof, and readily performed, ut for the Learners better Proficiency, I would adiſe him to prove his Queſtion backward, as you nay ſee in the Example of the 4th and 5th of this Rule.

Note, When the firſt of the three given Terms in the *Rule of Three direct* is 1 or Unity, the Queſtion will on be anſwered by the *Rule of Practice*, which ſaid Rule I therefore place next to be learned.

CHAP. VIII.

Rules of PRACTICE.

1. IT is commonly called the *Rule of PRACTICE*, from the great Uſe and Practice thereof in common Affairs.

2. All Queſtions that are reſolved by this Rule, muſt have 1 or Unity for the Demand: As for Example; If 1 Ounce coſt 2 *s.* 3*d.* $\frac{1}{4}$. what will 28 Ounces.

3. In the farther Proſecution of this Rule, I ſhall begin with 1 Penny, and ſo proceed gradually by breaking all the aliquot Parts unto a Shilling; the Manner how will be ſeen in the Margent.

4. You muſt be perfect in your Table of Twelves, and to divide a ſingle Figure by Memory.

TABLE of Twelves.

1	12	12
2	12	24
3	12	36
4	12	48
5	12	60
6	12	72
7	12	84
8	12	96
9	12	108
10	12	120
11	12	132
12	12	144

I ſhall for the better underſtanding and help to he Learner, to initiate him in this *Rule of Practice*, egin with the even Parts of a Shilling.

Queſt. 1. What comes 48 Yards to at 1 *d. per* ard.

Anſwer, 3 *l.* 19 *s.*

Yards *d.*
2) 948 at 1 *per* Yard.
7| 9—00
3|19—00

When the Price is an
en Part of a Shilling,
onſider what Part it is;
hich being found, di-
ide the Sum propound-
d by it, and the Anſwer
vil be in Shillings, which
y cutting off the laſt Fi-
ure, you convert into
ounds.

oz. *d.*
*Qu.*2. 8)3618 at 1 ½ *p. oz.*
45|2—3—00
nſwer, 22|12—3

Ells *d.*
6) 4956 at 2 *per* Ell.
82|6—00
Anſ. 41|6—00

l. *d.*
4) 276 at 3 *per* ℔.
6|9—00
Anſ. 3|9—00

Ells *d.*
3) 867 at 4 *per* Ell.
28|9—00
Anſ. 14|9—00

Yards *d.*
2) 9756 at 6 *per* Yard.
487|8—00
Anſ. 243|18—00

Having gone thus far, I ſhall now proceed gradually from one Penny to a Shilling.

Yard *d.*

12) 549 at 1 *per* Yard.

4|5 : 9

2|5 : 9

Days *d.*

12) 7869 at 1 $\frac{1}{4}$ *per* Day.

4) 655 : 9

163 : 11 : $\frac{1}{4}$

81| 9 : 8 : $\frac{1}{4}$

40|19 : 8 : $\frac{1}{4}$.

The Explanation of this Queſtion.

You may by this Queſtion, obſerve that as 1 *d* is the $\frac{1}{2}$ of a Shilling, and ſo 1 Farthing is the $\frac{1}{4}$ of that Penny, ſo by Conſequence dividing 655 Shillings and 9 Pence by 4, there is found 163 Shillings 11 Pence 1 Farthing; which being added, there will be found 819 Shillings, 8 Pence 1 Farthing, which being converted i to Shillings, makes

40 *l.* 19 *s.* 8 *d.* 1

Days *d.*

8) 748 at 1 $\frac{1}{2}$ *per* Da

9| 3 : 6

4|13 : 6

Ell. *d.*

8) 5260 at 1 $\frac{3}{4}$ *per* Ell

6) 657 : 6

109 : 7

76|7 : 1

38|7 : 1

Note, This Queſtion thus performed, firſt, ſay 1 *d.* $\frac{1}{2}$ is the $\frac{1}{8}$ of Shilling, and then 1 Fa thing is the $\frac{1}{6}$ of th Line, as *per* the Oper ration.

Yards *d.*

6) 9510 at 2 *per* Yard

158|5 : 00

79|5 : 00

d.

3482 at 2 ¼

580 : 4

72 : 6 : ½

65|2 : 10 : ½

32|12 : 10 : ½

l. *d.*

9790 at 2 ½ *per* ℔.

1631 : 8

407 : 11

203| 9 : 7

101|19 : 7

Days *d.*

7950 at 2 ¾ *per* Day.

1325 : 00

331 : 03

165 : 07 ½

182|1 : 10 : ½

91|1 : 10 : ½

Note, By Reaſon 3 Far-ings is no equal Part of 2 Pence, it is therefore broke into a Halfpenny, and a Farthing, and the Work ſo divided.

oz. *d.*

4) 768 at 3 *per oz.*

19| 2 : 00

9|12 : 00

Dram *d.*

4) 4270 at 3 ¼ *p.* Dram.

12)1067 : 6

88 : 11 : ½

115|6 : 05 : ½

57|16 : 05 : ½

Yards *d.*

4) 594 at 3 ½ *per* Yard.

6) 148 : 6 : 0

24 : 9 : 0

17| 3 : 3 : 0

8|13 : 3 : 0

4)

℔ *d.*
4) 5968 at 3 ¾ *p.* ℔.

4) 1492 : 00
373 : 00

186|5 : 00

93|5 : 00

oz. *d.*
3) 482 at 4 *per* Ounce.

16|0 : 8

8|0 : 8

Ells *d.*
4) 7984 at 4 ¼ *p.* Ell.

3) 1996 : 00
4) 665 : 04
166 : 04

282|7 : 08

141|7 : 08

This Queſtion of 7984 Ells at 4 *d.* ¼ muſt be broke thus; for by Reaſon that 1 Farthing is no even Part of 4 *d.* (within the Compaſs of the Table of Twelves, ther fore you muſt ſay, th 3 *d.* is the ¼ of a Shillin 1 *d.* the ⅓ of three Penc and 1 Farthing the ¼ that Penny; as by th foregoing Operation.

Days *d.*
3) 642 at 4 ½ *per* Da

8) 214 : 00
26 : 09

24|0 : 09

12|0 : 09

Yards *d.*
3) 7684 at 4 ¾ *p.* Yar

8) 2561 : 4
2) 320 : 2
160 : 1

204|1 : 7

152|1 : 7

Again, *Ells* *d.*
3) 5971 at 5 *per* El

4) 1991 : 4
447 : 10

243|9 : 02

121|19 : 02

d.
6480 at 5 ¼ per Ell.

2160 : 0
540 : 0
135 : 0

283|5 : 0

141|15 : 0

d.
) 916 at 5 ½

305 : 4
114 : 6

41|9 : 10

20|19 : 10

Note, In this Queſtion may ſee that 916 is ded both by 3 and 8, auſe that 4 *d.* is the f a Shilling, and 1 *d.* ½, he ⅛ of a Shilling.

Yards *d.*
) 7613 at 5 ¾ *per* Yd.

) 2537 : 8
951 : 7 ½
158 : 7 ¼

364|7 : 10 ¾

182|7 : 10 ¾

Days *d.*
2) 9174 at 6 *per* Day.

458|7 : 00

229|17 : 00

Ells *d.*
3) 796 at 6 ¼ *per* Ell.

2) 265 : 4
8) 132 : 8
16 : 7

41|4 : 7

20|14 : 7

Note, Here 6 *d.* is divided into two Parts, *viz.* 4 *d.* and 2 *d.* to bring in the odd Farthings

Yards *d.*
2) 5410 at 6 ½ *per* Yard.

12) 2705 : 00
225 : 05

293|0 : 5

146|10 : 5

Yards *d.*
2) 719 at 6 ¾

4) 359 : 6
89 : 10 ½

44|9 : 4 ½

22|9 : 4 ½

d.
2) 5270 at 7

6) 2635 : 0
439 : 2

307|4 : 2

153|14 : 2

d.
2) 6510 at 7 ¼

6) 3255 : 0
4) 542 : 6
135 : 7 ½

393|3 : 1 ½

196|13 : 1 ½

d.
8) 2) 3954 at 7 ½

1977 : 0
494 : 3

247|1 : 3

123|11 : 3

d.
4) 3) 9104 at 7 ¾ *p.* Y

3034 : 8
4) 2276 : 0
569 : 0

587|9 : 8

293|19 : 8

Note, The aliq
Parts are broke th
4 *d.* is the ⅓ of a Sh
ling, 3 *d.* the ¼ of a Sh
ling, and 3 Farthings
¼ of 3 Pence.

oz. *d.*
⅔) 2744 At 8 *p. oz.*

914 : 8
914 : 8

1829 : 4

Or thus,

d.
2744 at 8 *per oz.*

1372 : 00
457 : 04

182|9 : 04

91|9 : 04

ote, Both theſe Que- ns anſwer one another, ough the aliquot ts are broke diverſly ; 8 *d.* is the $\frac{2}{3}$ of a Shil- g in the firſt, and in ſecond Sum it is ke by 6 *d.* and 2 *d.*

d.
7370 at 8 $\frac{1}{4}$.

3685 : 00
1228 : 04
153 : 06 $\frac{1}{2}$

506|6 : 16 $\frac{1}{2}$

253|6 : 10 $\frac{1}{2}$

d.
2) 9190 at 8 $\frac{1}{2}$.

3) 4595 : 00
4) 1531 : 08
382 : 11

650|9 : 07 : 0

325|9 : 07

d.
2) 5182 *at* 8 $\frac{1}{4}$.

3) 2591 : 00
4) 863 : 08
2) 215 : 11
107 : 11 $\frac{1}{2}$

377|8 : 06 $\frac{1}{2}$

188|18 : 06 $\frac{1}{2}$

2) 9999 at 9 *d.*

2) 4999 : 6
2499 : 9

749|9 : 03

374|19 : 03

2)

d.
2) 6166 at 9 ¼

2) 3088 : 00
12) 1544 : 00
128 : 08

476|0 : 08

238|0 : 08

d.
2) 7184 at 9 ½.

2) 3592 : 00
6) 1791 : 00
298 : 06

568|1 : 06

284|1 : 06

d.
2) 3111 at 9 ¾.

2) 1555 : 06
4) 777 : 03
194 : 03 ¾

252|7 : 00 ¾

126|7 : 00 ¾

Days d.
⅔) 5910 at 10 *per* D

1970 : 00
2) 1970 : 00
985 : 00

492|5 : 00

246|5 : 00

Days d.
3) 2) 5910 at 10 *p.* D

2955 : 00
1970 : 00

492|5 : 00

246|5 : 00

d.
3) 7177 at 10 ¼.

2392 : 4
2) 2392 : 4
8) 1196 : 2
149 : 6 ¼

613|0 : 4 ¼

306|10 : 4 ¼

Days *d.*
397 at 10 ½

132 : 4
132 : 4
66 : 2
16 : 6 ½

34|7 : 4 ½

17|7 : 4 ½

d.
) 528 at 10 ¾

) 264 : 00
176 : 00
33 : 00

47|3 : 00

23|13 : 00

Days *d.*
4) ⅔) 5612 at 11 *p.* Day.

1870 : 8
1870 : 8
1403 : 0

514|4 : 4

257|4 : 4

Note, Obſerve that in this Queſtion, 8 *d.* is here taken out of the Shillings Line being ⅔, and the 3 *d.* being the ¼ out of the ſame Line for that 8 *d.* and 3 *d.* is eleven Pence.

Ells. *d.*
¼) ⅔) 3120 at 11 ¼ *per* Ell.

1040 : 00
1040 : 00
12) 780 : 00 taken out of the firſt
65 : 00 Line.

192|5 : 00

96|5 : 00

d.
4) $\frac{2}{3}$) 565 at 11 $\frac{1}{2}$

188 : 4 : 0
188 : 4 : 0
6) 141 : 3 : 0 the firſt Line
23 : 6 : $\frac{1}{2}$ vided by 4.

54|1 : 5 : $\frac{1}{2}$

27|1 : 5 : $\frac{1}{2}$

d.
$\frac{1}{4}$) $\frac{2}{3}$) 3102 at 11 $\frac{3}{4}$

1034 : 0 : 0
1034 : 0 : 0
4) 775 : 6 : 0
193 : 10 : $\frac{1}{2}$

303|7 : 4 : $\frac{1}{2}$

151|17 : 4 : $\frac{1}{2}$

Days *s.*
5384 at 1 the Day.

538|4 Only ſet down the Su
and cut off the laſt
269|4 gure and halve it.

If the Queſtions after propounded be more th
one Shilling, it is but multiplying the Sum by ſo m
ny Shillings, and cut off the laſt Figure to convert
into Pounds, as hath been performed throughout.
A few Examples will demonſtrate the Reaſon.

As for EXAMPLE.

```
  Ells     s.
  596 at 2 p. Ell.
    2
  ---------------
2|0) 119|2
  ---------------
      59|12
  ---------------

  Yards      s.
  7694 at  8 per Yard.
     8
  ---------------
2|0) 6155|2
  ---------------
     3077|12
  ---------------

  Day       s.
  3148 at 12 per Day.
    12
  ---------------
  6296
 3148
  ---------------
2|0)3777|6
  ---------------
    1888|16
  ---------------
```

Days *s.*
365 at 16 *per* Day.
16

2190 16 *s.* a Day is 292 *l.*
365 Year.

584|0

292|0

If the Queſtion be propounded in Pounds, it
but turning the Pounds into Shillings, and multi
them as before taught.

As for EXAMPLE.

l. *l.* *s.* *d.*
728 at 1 : 17 : 00
37

5096
2184

2693|6

1346|16

So that 728 Pounds of Indico coſt one Pound ſe
teen Shillings, the Anſwer will be found 1346 Pou
ſixteen Shillings.

Note, If the Queſtion be propounded in Pou
Shillings, Pence and Farthings, 'tis but conver
the Pounds into Shillings, and taking in the Shill
to the Pounds, and for the odd Pence and Farthi
they muſt be broken into the Parts of a Shil
and taken out of the given Sum.

So that the whole Rule of *Practice* is by this Way lly learn'd and taught, by Reaſon nothing can be opoſed from a Penny to a Shilling, but what is oke into the even Parts: A few Examples will ake it fully appear.

Thus,

```
        Yards  l.   s.  d.
  2)    724 at 2 , 12 : 6 ½
          52
      ____________________
       1448
      3620
      __________
      37648 : 0
 12)   362 : 0
         30 : 2
      __________
      3804|0 : 2
      ____|_______
      1902|0 : 2
```

Anſwer, 1902 *l.* 0 *s.* 2 *d.* 0 *f.*

Some more Examples, it is preſumed, will make you perfect.

Ells *l.* *s.* *d.*
8) 2) 3271 at 3 : 15 : 7 ½.
75

16355
22897

245325
1635 : 6
408 : 10 ½

24736|9 : 04 ½

12368|9 : 04 ½ Anſwer.

C.wt. *l.* *s.* *d.*
3) 242 at 5 : 15 : 4 ½ *per* Hundred-wei

115

5 *l.* 15 *s.* is
Shillings

1210
242
242

27830
8) 80 : 8
10 : 1

2792|0 : 9

1396|0 : 9 Anſwer.

For the better underſtanding of this laſt Queſtion, ill prove it by the *Rule of Three direct.*

```
  C.      l.  s.  d.              C.
f 1 coſt 5 : 15 : 4 : ½ what will 242
         20
        ----
        115
         12
        ----
        234
       115
      ------
       1384
          4
     -------
       5538
        242
     --------
      11076
     22152
    11076
   ----------- 12)
)1340196(335049(2792|0
 ......  24....       -----------
        0 ---         1396 : 00 : 09 : 00
          95
          84
         ----
          110
          108
          ----
            24
            24
           ----
            09
```

nſwer, The ſame with the Rule of *Practice* ; *1396 l. 00 s. 09 d. 00 f.*

Practice of Avoirdupois-Weight.

WHERE the Quantity, whoſe Price is ſought, conſiſts of entire Hundred Weights, Quarters of an Hundred-weight, and of ſome Number Pounds, which is not an aliquot Part of 28 ℔, ¼ of an Hundred-weight.

As in this EXAMPLE.

```
           C.   qrs.  ℔        l.    s.   d.
     3)   973 : 3 : 21  at  3  :  12  :  4 per C.
           72
    ------------------------------------------
         1946
        6811
    ----------
        70056 : 0
          324 : 4
   Qrs.—   18 : 1
           18 : 1
     2)    18 : 1
     2)     9 : [illegible] : ½
            4 : 6 : ¼
    ----------------
       7044|8 : 1 : ¾
    ----------------
       3522|8 : 1 : ¾
    ----------------
```

For 3 *qrs.* take the ¼ Price, and ſet it times down, becau it is 3 *qrs.*

℔	*qr.*
14 ½ of	1
7 ½ of	14 ℔.

Anſwer.

```
          C.  qrs. ℔.    l.   s.   d.
   2)   218 : 3 : 24 at 5 : 15 : 7 : 1/4
        115
   ──────────
        1090
        218
       218
   ──────────────────
       25070 : 00 : 0
   6)—109    : 00 : 0
    4)—18    : 02 : 0
        4    : 06 : 1/2
 3 Qrs 28    : 10 : 3 1/4
       28    : 10 : 3 1/4
   2)  28    : 10 : 3 1/4
7) 2)  14    : 05 : 1 3
        7    : 02 : 2 3
        2    : 00 : 3
        2    : 00 : 1
   ──────────────────────
   2532|2    : 03 : 2
   ──────────────────────
   1266|2    : 03 : 1/2
   ──────────────────────
```

℔		qrs.		℔.
14	: $\frac{1}{2}$	: 1	or 18	
7	: $\frac{1}{2}$	: 14		
2	: $\frac{1}{7}$	: 14		
1	: $\frac{1}{2}$	: 2		℔.

o that the Anſwer to the Queſtion will be found be very near 1266 *l.* 2 *s.* 03 *d.* $\frac{1}{2}$

The Example laſt-mentioned being (of thoſe eſtions, which ordinarily happen in Trade) one the hardeſt to be reſolved by the *Rule of Practice*, all therefore illuſtrate and explain the foregoing eration, where you may obſerve the Price of C. 3 *qrs.* to be found after the Manner of former mples: Then for 24 ℔. take 14 ℔. Part of

the 24, I take $\frac{1}{2}$ of the Price of 1 *gr.* or 28.) Lik
wiſe for 7 ℔. I take half the Price of 14 ℔. and
there yet remains 3 ℔. which I divide into two Par
by ſaying 2 ℔. is the $\frac{1}{7}$ of 14 ℔, and 1 ℔ the $\frac{1}{2}$
2 ℔. Laſtly, all being added together, the Sum
found to be very near 1266 Pounds, 2 Shilling
3 Pence and 2 Farthings.

```
            C.                 l.   s.  d.
  8)  2)    08 of Sugar at 3 : 13  7 ½ per C.
            73
  ----------------------------------------
            24
           56
         -----
           584
             4
             1
         -----
           58|9
         ------
           29|9 : 00
         ---------
```

Answer, 29 *l.* 09 *s.* 00 *d.*

Another EXAMPLE.

C. *qrs.* ℔. *l.* *s.* *d.*
2) 28 : 1 : 20 at 2 : 15 : 9 ½ *per* C.
55

140
140

1540 : 00 : 00
2) 14 : 00 : 00
6) 07 : 00 : 00 *Qrs.* ¼ of the Price.
01 : 02 : 00 *mit.*
s.7) 2) 13 : 11 : 01 : 3 ℔ ℔
6 : 11 : 02 : 4 14 : ½ of 28
1 : 11 : 03 : 3 4 : 1/7 of 28
0 : 11 : 03 : 4 2 : ½ of 4 ℔.

158|6 : 00 : ¾ : 3 *Mites.*

79|6 : 00 : ¾ : 3 *Mites.*

Anſwer, 79 *l.* 06*s.* 00 *d.* ¾ *far.* 3 *mites.*

Thus much for the *Rule of Practice*, which if ll underſtood, you may with a very little Care, rten all your Accounts whatſoever. The next in rder is the *Rule of Three Indirect*.

CHAP. IX.

The Rule of Three *Indirect.*

1. THE *Rule of* Three *Indirect*, (or *Inverſ* is when the fourth Term requir ought to proced from the ſecond Term according to the ſame Proportion a the Firſt proceeds from the third.

2. And becauſe many Queſtions ſeem very ambiguous, whether they belong to the *Rule of* Three *Direct*, or *Indirect*,

Obſerve the Directions following.

Direct Proportion is when the greater it is, th greater it requires the fourth Term to be; and th leſs it requires, the fourth Term muſt be leſſer.

Indirect Proportion is, when that Term by whic the Queſtion is made, the greater it is, the leſs i requires the fourth Term to be; the Leſs, it requir the fourth Term to be the greater. *Oughtred*'s *Clavis Mathematicæ.*

Or when greater requires greater, and leſs requir leſſer, it is *Direct*: But when greater requires leſſe and leſſer greater, it is *Indirect*.

As for ***EXAMPLE.***

Queſt. 1. If 100 Workmen finiſh a Piece of Work 12 Days, how many Workmen are ſufficient to the ſame in 3 Days?

Anſwer, 400 Workmen.

The given Numbers being thus ranked, multiply firſt **Term** by the ſecond, and divide the Prot by the third, ſo the Quotient ſhall be your ſwer.

Days *Workmen* *Days*
If 12——100——3
12
——
1200
——
3)1200)400 Workmen.
——

Queſt. 2. If 10 Men build a Wall in 20 *Days* in t Time will 3 Men build it?

Men *Days* *Men*
10——20——3
10
——*Days*
3)200(66 $\frac{2}{3}$
18
——
20
18
——
2
——

ere more being re-
ed, 3 the leſſer ex-
e is the Diviſor.

Queſt. 3. How many Ells *Engliſh* of Ell Breadt will line 20 Yards of 3 Quarters broad.

Anſwer, *9* Ells $\frac{3}{5}$ *Engl.*

```
qrs.          Yards          qrs.
3 ——————————— 20 ——————————— 5
               4
              ——
              80
               3 qrs.
              ——— 5) Ells Engl.
           5)240(48(9 : 3/5
             20·· 45·
             ———— ——
              40  3
              40
              ——
               0
              ——
```

Queſt. 4. If 100 *l.* in 12 Months gain 10 *l.* fo the Intereſt thereof, I demand what Principal wil gain the ſame Intereſt in 8 Months?

```
Months         l.        Months
12 ——————————— 100 ——————— 8
               12
             ———— l.
          8)1200(150 for Anſwer.
            8··
           ————
            40
            40
           ————
            00
           ————
```

For the ſhorter the Time, the more muſt be th Principal to gain the ſame Intereſt. *Queſt.*

Queſt. 5. If for the matting of a Room there is equired 100 Yards of a Yard broad, how many ards will be required of 1 Yard and ½ broad.

Anſwer 66 *Yards* ⅔.

```
Yard        Yards        Yard  Qrs.
  1 ---------- 100 ---------- 1 : 2
  4            4             4
 ---          ---           ---
  4           400            6
 ---          ---           ---
            6)400(66 : 4/6 | 2/3
               ..4
               ---
```

Queſt. 6. A Regiment of Soldiers conſiſting of ooo Men, are to have new Coats, and each Coat o contain 2 Yards, 2 Quarters of Cloth that is Quarters wide, and they are to be lin'd with Shalloon that is 3 Quarters wide, I demand how many ards of Shalloon will line them?

```
Yards   Qrs.            Men
  2  :  2              1000
  4                      10
 ---                  -----
 10                   10000 Quarters.

Qrs.  [illegible] Qrs      Quarters
  5 ------ 10000 ------ 3
              5
         -------- Qrs.
       3)50000(16666 2/3
         :....
           2
       -------- Qrs.          Yards
                16666 2/3 = 4166  3
                Yards
```

Anſwer, 4166 ¾ of Shalloon.

Queſt. 7. How much Money muſt I lend
12 Months, to requite my Friend who lent me 7
Pounds for 6 Months.

Anſwer, 365 *l.*

Months *l.* *Months*
6——730——12
6

12)4380(365 Pounds.
36
78
72
60
12
0

By lending me a grea
Sum for a leſs Ti
I muſt lend him a l
Sum, for a lon
Time.

Queſt. 8. If an Acre of Land be 4 Perches bro
the Length by Conſequence muſt be 40. Now
the Breadth be 8 Perches $\frac{1}{2}$, what Length muſt
have to make an Acre.

Perches broad *p. long* *p. broad.*
4——40——8 $\frac{1}{2}$
4 16 4
16 240 34
40
——*Perches long.*
34)640(18 $\frac{28}{34}=\frac{14}{17}$.
34
300
272
28 Anſwer, 18 $\frac{14}{17}$ Perches lon

Th

The Proof of the *Single Rule of* Three *Indirect* is, the Product of the fourth Term multiplied by the rd, be equal to the Product of the ſecond multi ed by the firſt, then is the Queſtion rightly per med, if not, erroneous.

As for Example in the ſeventh Queſtion.

Months	*l.*	*Months*	*l.*
6	730	12	365
	6		12
	4380		4380

The next Rule in Order, is the *Double Rule of* ree *Direct*.

CHAP. X.

The Double Rule of Three *Direct.*

THIS *Direct Rule* is, when both the fin
Rules do each of them look for
fourth Term in a direct Proporti
and is performed by 2 ſingle *Rule*
Three Direct.

As for EXAMPLE.

Queſt. 1. If the Carriage of 7 *C.* Weight 128 M
coſt 48 Shillings, how much Money muſt I
for 3 *C.* Weight carried 32 Miles after the ſame R
Thus performed:

C. *s.* *C.*
If 7 Weight coſt 48——3
12
576
4
2304
3
4 12 *s.* *d.*
7)6912(987(246 (20 6
63
3 6
61
56
52
49
3

Queſt. 1. Then for the ſecond Queſtion, ſay,

Miles *s.* *d.* *Miles.*

If 128 coſts 20 : *6* : $\frac{3}{4}$ what will 32

12

246

4

987

32

1974

2961

4 12 *s.* *d.*

128)31584(246(61(5 : 1 $\frac{1}{2} = \frac{96}{128} = \frac{3}{4}$

256 60

2 —

— 1

598

512

864

768 Anſwer, 5 *s.* 1 *d.* $\frac{1}{2}$ $\frac{3}{4}$

96

*Queſt.*2. What comes the Intereſt of 192 *l.* 14 *s.* 10*d.* for 830 Days at 5 *l. per Cent. per Ann.*

l. *l.* *l.* *s:* *d.*

100——5——192 : 14 : 10

Anſwer, *9 l.* 12 *s.* 8 *d.* $\frac{3}{4}$.

Days *l.* *s.* *d.* *Days*

Then if 365——*9* : 12 : 8 $\frac{3}{4}$——830

The final Anſwer is 21 *l.* 18 *s:* 03 *d.*

Queſt. 3. What comes the Intereſt of a Bond of 92 *l.* 15 *s.* for 3 Months, 3 Weeks and 4 Day 6 *l. per Cent.*

```
     l.          l.         l.    s.
If 100————————6————————92 : 15
     20         20        20
   ————       ————      ————
   2000        120      1855
                         120
                        ————
                        37100
                       1855
                       ——————
                       222600
                       ——————

     2|000(222|600(11|1
                   ————   d.
                    5|11 : 3 1/2.
                    ————
```

Then if

```
Days    l.    s.    d.              Days
365 ——— 5  :  11 :  3 ½  what will  109
        20
      ————
       111
        12
      ————
      1335
         4
      ————
      5342
       109
      ————
     48078
    53420
   ——————— 4      12
365)582278(1595(398(3|3
    365···   ···  36·———l.   s.   d.
   ———————    3  ————    1 : 13 : 2 ¼
    2172          38     For Answer.
    1825          36
   ——————        ————
     3477          2
     3285        ————
    ——————
      1928
      1825
     ——————
       103
     ——————
```

CHAP. XI.

The Double Rule of Three *Indirect*

Performed by two ſingle Rules.

Queſt. 1. IF 24 Rods of Brick-work req
4 Men to finiſh it in 12 D
how many Men will 384 R
require to finiſh it in 48 D

```
            Rods        Men          Rods
Direct      24————————4————————————384
                         Men          4
                24)1536(64          ———
                 · 144               1536
                   ———               ———
                    96
                    96
                   ———
                    0
      Days           Then          Days
   If 12————————64 Men————————48   Indire
                  12
                 ———
             48)768(16
                48··
                ———
                288
                288
                ———
                 0
```

If one of them happens to be a Rule Ind
that double Rule is called *Indirect.*

Queſt. 2. If 100 *l.* Principal in 12 Months in 6 *l.* Intereſt, what Principal will gain 3 *l.* 7 *s.* 6 *d.* Months?

Anſwer 75 *l.*

Thus,

Months *l.* *Months*

Indirect 12——100——9

12

l. *s.* *d.*

9)1200(133 $\frac{3}{9}$=6 : 8

9

36

27

30

27 $\frac{3}{9}$=

3

l. *l.* *s.* *d.* *l.* *s.* *d.*

If 6 Int.——133 : 6 : 8——3 : 7 : 6

Reduced is,

Pence *Pence* *Pence*

Direct 1440——32000——810

810 mult.

12

1440)25920000(18000(150|0

75

Anſwer, 75 *l.*

Queſt. 3. How long Time was 900 *l.* gaining 420 when 6 *l.* was gained of 100 in 12 Months?

Anſwer, 93 *Months*, $\frac{1}{3}$

Int. *Princ.* *Int.*
6 *l.*———100 *l.*———420 *l.*
Anſwer, 7000 Principal.

Then if

Principal *Months* *Principal*
7000 *l.*———12———900 *l.*
12
———
84000 *Months*
900)84000(93 $\frac{1}{3}$ Part of a Mon

Queſt. 4. Of what Principal was 150 *l.* gai in 19 Months, when 100 *l.* in 12 Months Gain

Anſwer, 1578 $\frac{18}{19}$ Principal.

Thus,

l. *Prin.* *l.*
6———100———150 *Int.*

Anſwer, 2500 Princip

Then,

Months *Months*
12——2500 *Principal*——19
12

19)30000(1578 $\frac{18}{19}$. or
19···· *l.* *s.* *d.*
1578 : 18 : 11 $\frac{1}{4}$ $\frac{9}{19}$.
110
095
150
133
170
152
18

Queſt. 5. If 6 Mowers will mow 45 Acres in 5 ays, how many Mowers will mow 300 Acres in 6 ays?

Anſwer, 33 Mowers $\frac{1}{3}$.

Acres *Mowers* *Acres*
45 ———6 ——— 300
6
1800

Mowers
45)1800(40
180··
00

Then

Then,

Days — *Mowers* — *Days*

If 5——40——6

5

——*Mowers*

6)200)33 $\frac{1}{3}$

18··

——

20

18

——

2

——

But a more particular Application will be made of the *Double Rule of Three*, and a more compendious working ſhall be ſhewn, when I ſhall come to the Rule of *Simple-Intereſt*.

CHAP.

CHAP. XII.

The Rule of Fellowſhip.

Note, *The* Rule of Fellowſhip *is either Single or Double.*

THE Single Rule is, when the Stocks propounded do continue in the common Bank equal Times, that is to ſay one Man's Stock continueth as long Time as another.

As for EXAMPLE.

Queſt. 1. Two Merchants *A* and *B.* were Sharers a Parcel of Goods; for the Purchaſe of which, laid out 13 *l.* 7 *s.* 4 *d.* and *B* 8 *l.* 9 *s.* 3 *d.* Now pon Sale of theſe Goods they gain 5 *l.* 17 *s.* 5 *d.* would know what is the Gain of *A*, and what f *B.*

How to work the Single Rule of Fellowſhip.

Take the Total of all the Stocks, for the firſt erm in the *Rule of Three Direct*; the whole Gain Loſs, for the ſecond; and the particular Stocks r the third: This done, repeating the *Rule of Three* often as there are particular Stocks in the Queſtion e fourth Term produced upon thoſe ſeveral Operations,

rations, are the reſpective Gains or Loſſes of thoſe Particular Stocks propounded: So in this firſt Example abovementioned according to the Queſtion.

	l.	*s.*	*d.*
A laid out	13 :	07 :	4
B laid out	8 :	09 :	3
Total	21	16 :	7

	l.		*s.*		*d.*		*l.*		*s.*		*d.*		*l.*	*s.* *d.*
So if	21	:	16	:	7	gain	5	:	17	:	5	what	13	: 7 : 4

	l.	*s.*	*d.*	
Facit A	3 :	11 :	11	Part.
B	2 :	05 :	06	Part.
	5 :	17 :	05	In all.

If both the Shares added together make up the whole gains, then is your Queſtion rightly done.

Queſt. 2. *A, B, C,* freight a Ship with 70 Tuns of Wine, whereof *A* loaded 30 Tuns, *B.* 24, and *C.* 16 Tuns, by Reaſon of tempeſtuous Weather at Sea, they threw overboard 10 Tuns, how much of this Loſs muſt each of theſe Merchants have?

		Tuns,		
Anſwer,	*A.*	4 :	$\frac{2}{7}$	
	B.	3 :	$\frac{3}{7}$	The Fractions
	C.	2 :	$\frac{2}{7}$	make 1 Tun
		1 :		amongſt them.
		10 :	0	

Queſt. 2. Thus the Operation is performed.

Tuns *Tuns* *Tuns*
70——10——30
10
——*Tuns*
70)300(4 $\frac{20}{70}=\frac{2}{7}$ *A.* Loſs.
280
——
20

Tuns *Tuns* *Tuns*
70——10——24
10
—— *Tuns*
70)240(3 $\frac{30}{70}=\frac{3}{7}$ *B.* Loſs.
——
240
210
——
30

Proof.
4 : $\frac{2}{7}$ *A.*
3 : $\frac{3}{7}$ *B.*
2 : $\frac{2}{7}$ *C.*
——
10
——

Tuns *Tuns* *Tuns*
70——10——16
10
——*Tuns*
70)160(2 $\frac{20}{70}=\frac{2}{7}$. *C.* Loſs.
140
——
20

Queſt. 3. A Debtor dies indebted to 8 Creditors, *viz.* To

	l.
A.	100
B.	86
C.	75
D.	60
E.	54
F.	32
G.	24
H.	15
In all	446

The Value of his Eſtate at his Death amounted only unto 150 *l.* what muſt each Man have.

Work accordingly by 8 *Rules of Three*, and you will find the Quotients thus:

	l.	*s.*	*d.*	*f.*
Unto *A.*	33	12	07	2
B.	28	18	05	2
C.	25	04	05	3
D.	20	03	07	0
E.	18	03	02	2+2
F.	10	15	02	2+2
G.	08	01	05	0
H.	05	00	10	3+3
In all	150	00	00	0

Queſt. 4. Three Farmers hired a Shepherd to keep their Sheep for 7 *l.* 10 *s.* a Year. The firſt committed 430 Sheep to his keeping, the ſecond 357, and the third 500 Sheep, what muſt each Farmer pay according to his Proportion

Work as before by the three *Rules of Three Direct,* nd you will find.

	l.	*s.*	*d.*	
Firſt Farmer	2 :	10 :	1	+
Second Farmer	2 :	01 :	7	+ *facit* 1 Penny.
Third Farmer	2 :	18 :	3	+
			1	
Proof	7 :	10 :	0	

Queſt. 5. Three Merchants made a Company. *A.* put in 600 *l.* *B.* put in ſo oftentimes 50 *s.* as *A* put in 40 *s.* *C.* put in ſo oftentimes 70 *s.* as *B.* put n 60 *s.* and they gained together 500, I demand what each Man muſt have, and what each Man put in.

In Queſtions of this Nature, the particular Stocks nmentioned, muſt be found out by that which is nentioned.

As for Example, to find what Stock B. *put in ;*

Thus :

l. *l.* *l.*
4——600——5
5
—— *l.*
4)3000(750 *B.* put in.

Again, to find out *C.* then ſuch Reaſon as 6 hath to the Money, which *B.* put in, ſuch Reaſon muſt 7 have to the Money which *C.* put in.

l. *l.* *l.*

6——750——7

7

6)5250(875 *l. C.* put in.

48···

45

42

30

30

0

Thus they put in,

	l.
A.	600
B.	750
C.	875
In all	2225

By three Rules of *Three p.* Operation.

l. *l.* *l.*

Queſt. 5. If 2225 gain 500 what 600

500

300000

A.

2225)300000($134\frac{1850}{2225}$.

2225···

7750

6675

10750

8900

1850

l. *l.* *l.* *l.*
2225——500——750—168 = $\frac{1200}{2225}$ *B.*

2225——500——875—196 = $\frac{1400}{2225}$ *C.*

Anſwer Fractions make 2 *l.*
A. 135 + 1850
B. 168 + 1200
C. 196 + 1400
2

Proof 500

Queſt. 6. Three Merchants made a Company *D*, *E*, *F*, whereof *D*. put in 437 *l.* *E*. put in 211 *l.* and they gained together 562 *l.* whereof *F*. muſt have 187 *l.* 05 *s.* I demand *D*. and *E*. Shares, and what *F*. put into Company.

To find what *F*. put in, ſubtract his particular Gain from the whole Gain.

l. *s.*
562 : 00
187 : 05

374 : 15

Then add *D* and *E*'s Stock together.

437 *D.*
211 *E.*

648

If

l. *s.* *l.* *l.*
Then ſay, If 374 : 15——648 Stock——187 :
20
7485

F. put in.
7485)2433240(325 $= \frac{0615}{7485}$.
22455
18774
14970
38040
37425
615

20
3755
648
30040
15020
22530
2433240

Then to find *D.* and *E.* Part of the Profit.

Say, if

l. *l.* *l.*
648———374 : 05 total Stock——437 *D.*
Anſwer, 252 *l.* 07÷^{489},

l. *l.* *l.*
648———375 : 05———211 *E.*
Anſwer, 121 *l.* 17 *s.* ^{159},

PROOF.

Fract. *facit* 1 *s.*
D. 252 : 07+489
E. 121 : 17+159
F. 187 : 15+000

562 : 00+648 *facit.* 1 *s.*

Five Merchants, *viz.* *A*, *B*, *C*, *D*, and *E*, have ained 2025, which they divide into ſuch Sort, that the Share of *A.* is equal ſeverally to $\frac{1}{4}$ of the Share *B*, $\frac{1}{5}$ of *C*, $\frac{1}{6}$ of *D*, $\frac{1}{8}$ of *E*, the Queſtion is to ow what was the Share of each Merchant?

Anſwer, *A.* 162 *l.* *B.* 325 *l.* *C.* 405 *l.* *D.* 486 *l.* d *E.* 648 *l.*

Thus found out.

Divide a Number at Pleaſure into ſuch Parts, ich may be in ſuch Proportion as the Shares reired, and proceed according to the ſubſequent peration:

A.	2
B.	4
C.	5
D.	6
E.	8
	25

If 25 proceed from 2025——what will 2

Anſwer, 2=162 for *A.*
4=324 for *B.*
5=405 for *C.*
6=486 for *D.*
8=648 for *E.*

For according to the Queſtion,

	l.		*l.*
A.	162	whereof $\frac{1}{2}$ is	81
B.	324	whereof $\frac{1}{4}$ is	81
C.	405	whereof $\frac{1}{5}$ is	81
D.	486	whereof $\frac{1}{6}$ is	81
E.	648	whereof $\frac{1}{8}$ is	81
	2425		

According to the Tenor of the Queſtion for Proof.

CHAP. XIII.

The Double Rule of Fellowſhip.

Definition. DOUBLE FELLOWSHIP when the Stocks propounde are double Numbers, *vi* when each Stock hath R lation to a particular Time.

Operation. For the Operation, multiply each pa ticular Stock by its reſpective Time, and make t total of their Products the firſt Term; the Gain Loſs, the ſecond; and the ſaid particular Produ of the double Numbers, the third Term, and proceed as before taught.

As for EXAMPLE.

Queſt. 1. Three Butchers hired a Piece of Gro for 12 *l.* 10 *s.* 06 *d.* *A.* put in 20 Oxen for five D *B.* put in 16 Oxen for 7 Days, *C.* put in 25 O for 4 Days; now what muſt each of theſe Butch pay according to their Proportion.

Ox-Days

According to the Rule *A.* *B.* *C.* put in
20—5=1
16—7=1
25—4=1

3

Then by the Rule of Three *ſay,*

	l.	*s.*	*d.*	
If 312	12	10	6	will 100

Facit 4 *l.* 0 *s.* 3 *d.* + $\frac{6}{13}$. *A.* pays.

	l.	*s.*	*d.*	
312	12	10	6	112

Facic 4 *l.* 9 *s.* 11 *d.* + $\frac{1}{13}$ *B.* pays.

	l.	*s.*	*d.*	
312	12	10	6	100

Facit 4 *l.* 0 *s.* 3 *d.* + $\frac{6}{13}$ *C.* pays.

PROOF.

	l.	*s.*	*d.*	
A.	4	0	3	$\frac{6}{13}$.
B.	4	9	11	$\frac{1}{13}$. Fractions 1 *d.*
C.	4	0	3	$\frac{6}{13}$.
			1	
Proof	12	10	6	

Queſt. 2. Three Merchants enter into a Partner-p; *A.* put in 109 *l.* 5 *s.* for 3 Months, *B.* put 450 *l.* 7 *s.* for 4 Months, and *C.* 147 *l.* 12 *s.* for Months, and they gained in a Voyage to the ſt-*Indies* 209 *l.* 7 *s.* 2 *d.* I demand each Man's rt.

As by the Operation.

l. *s.*		*l.* *s.*		*l.* *l.*	
109—5 3	*mul.*	*B.*450—7 4	*mul.*	*C.*147-12 6	*mul.*
327—15		1801—8		885-12	

	l.	*s.*	
A.	327	15	
B.	1801	08	
C.	885	12	
	3014	15	Product.

l. *s.* *l.* *s.* *d.* *l.* *s.*
3014 : 15——gain 209 : 7 : 2 what 327 : 15
Facit 22 *l.* 15 *s.* 2 *d.* *A.*

l. *s.* *l.* *s.* *d.* *l.* *s.*
3014 : 15——gain 209 : 7 : 2 what 1801 : 8
Facit 125 *l.* 1 *s.* 11 *d.* *B.*

l. *s.* *l.* *s.* *d.* *l.* *s.*
3014 : 15——gain 209 : 7 : 2 what 885 : 1
Facit 61 *l.* 10 *s.* 0*d.* *C.*

PROOF.

	l.	*s.*	*d.*		*Fract.*
A.	22	15	2	*A.*	31240
B.	125	01	11		26103
C.	61	10	0		2592
			1		
					59935=1 *d.*
Proof	209	07	2		

Queſt. 3. A College in the Univerſity hath 20 Fel-
ws, and 30 Scholar, which doth diſpend yearly
600 Pounds; in this Manner, every Fellow hath 5 *l.*
r every Scholar 1 *l.* how much of this Revenue
arly belongs to the Fellows, and how much to the
holars?

	l.
Anſwer, to the Fellows	2000
To the Scholars	600
	2600

Thus found.

		l.
20 Mult. by 5 *l.*	*facit*	100
30 Mult. by 1 *l.*	*facit*	30
		130

Then

		l.	
130——2600——100	*Facit*	2000	Fellows.
30——2600—— 30	*Facit*	600	Scholars.
		2600	

eſt. 4. Two Merchants, *A.* and *B.* are in Part-
p: the Sum of their Stocks are 300 Pounds;
oney of *A.* continued in Company 9 Months,
Money of *B.* 11 Months, they gained 200
s, which they divided equally; the Queſtion

is to know how much each Merchant did pu
in:

l.
Anſwer, *A.*—165
B. —135

300 Stock.

Thus found, divide 300 into two ſuch Parts, a
may be in Proportion as 11 is to 9, ſo will th
greater Part be the Stock of *A.* and the leſſer
which Stocks being multiplied by their reſpecti
Times, the Products will be equal.

$$\left.\begin{array}{r}11\\9\end{array}\right\}\text{multiplied.}$$

20

Then if 20 give 300 what 11. Anſwer 165 for

20——300——9 Anſwer, 135 for *B.*

PROOF.

165 *A.*
135 *B.*

300

Queſt. 5. Three Merchants, *A, B, C,* enter P
nerſhip, and agree to continue in a joint Advent
16 Months. *A.* puts into the common Stock at
Beginning of the ſaid Term 100 Pounds, and
8 Months End he takes out 40 Pounds, and 4 Mo
after ſuch taking out he puts in 140 Pounds. *B.*
in at firſt 200 Pounds, and at 6 Months End,
puts in 50 more, and at 4 Months after the pu

n of the ſaid 50 Pounds, he takes out 100 Pounds. C. puts in at firſt 150 Pounds, at 4 Months End he akes out 50 Pounds, and at 8 Months after ſuch aking out, puts in 100 Pounds. Now at the End of he ſaid 16 Months they had gained 357 Pounds, he Queſtion will be to know, how much of the aid Gain belongs to each Merchant.

Note, That in all ſuch Queſtions as theſe, you nuſt carefully firſt obſerve the whole Time of Parterſhip, which is here 16 Months. Secondly, The eſpective Time, belonging to each Man's private tock, as you may obſerve in the Operation as fol- oweth, *viz.*

		l.
	Firſt Merchant. *A.* had 100 *l.* in the common Stock for 8 Months, therefore 100 multiplied by 8 is 800	*A.* 800
60 4 40	Alſo 60 *l.* for 4 Months is	240
00 4 800	Alſo 200 *l.* for 4 Months is 800	800
	The Total of the Products of Money and Time for *A.* is	1840
		l.
	Second Merchant. *B.* had 200 *l.* in common Stock for 6 Months, therefore 200 multiplied by 6 is 1200	*B.* 1200
250 4 000	Alſo 250 *l.* for 4 Months is 1000	1000
150 6 900	Alſo 150 *l.* for 6 Months is 900	900
	The Total of the Products of Money and Time for *B.* is	3100

		l.
150 4 600	*Third Merchant* C. had 150 *l.* in the common Stock for 4 Months, therefore 150 multiplied by 4 is	600
100 8 800	Alſo 100 *l.* for 8 Months is	800
200 4 800	Alſo 200 *l.* for 4 Months is	800
	The total of the Products of Money and Time for *C.* is	2200

The Queſtion continued, thus adding the ſai 3 Totals together, *viz.*

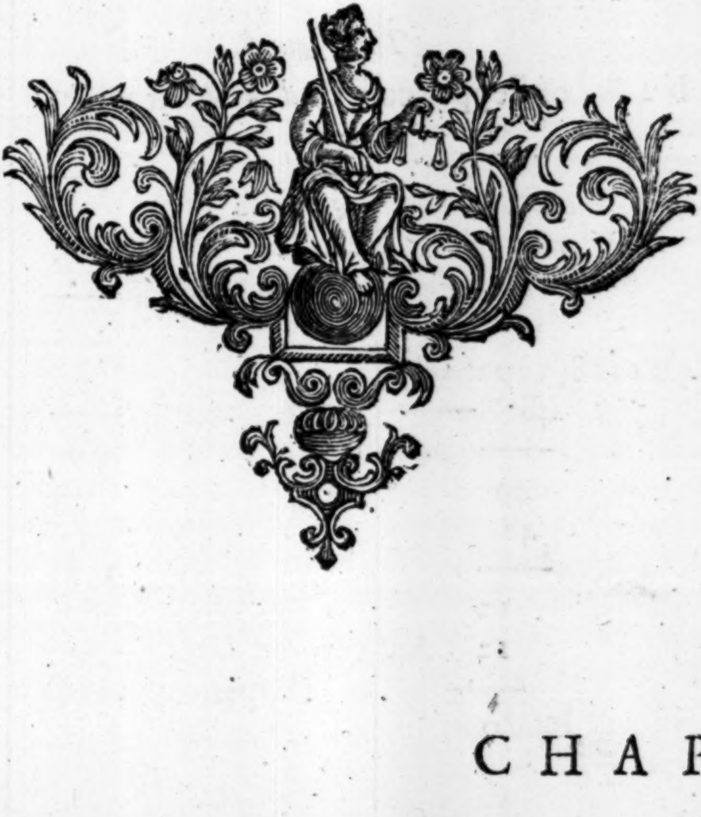
	l.	
A.	1840	add.
B.	3100	
C.	2200	
Sum is	7140	

Wherefore ſay by the *Rule of Three Direct*, 7140 i to the total Gain 357 *l.* ſo is 1840 *l.* to 92 *l.* th Gain of *A*. Again, as 7140 *l.* is to 357 *l.* ſo i 3100 *l.* to 155 *l.* the Gain of *B*. Laſtly, as 7140 is to 357, ſo is 2200 *l.* to 110 *l.* the Gain of

	l.	
A's Part is	92	add.
B's Part is	155	
C's Part is	110	
Total is	357	

The PROOF.

This Rule is proved by the adding of the Terms uired, whoſe Sum ought to be equal to the ſe- d Term in the Queſtion, otherwiſe the whole rk is erroneous.



CHAP. XIV.

BARTER.

DEFINITION.

BARTER, is the exchanging Wares Wares, or one Commodity for a ther.

As for EXAMPLE.

Two Merchants barter, *A.* hath 3 *C.* 2 *qrs.* of Pe per at 13 *d.* ½ *per* ℔. B. hath Ginger at 15 *d* ¼ *p.* I would know how much Ginger muſt be delive for the Pepper ?

Thus found.

1. If 1 ℔. of Pepper coſt 13 *d.* ½ what will 3 C. 2

```
                              4              4
                            ----           ----
                             54             14
                            ----            28
                                           ----
        12                                 112
4)21168(5292(44|3                           28
       48      ----                        ----
      ----      22—03                      392
        49                                  54
        48                                 ----
      ----                                1568
        12                                1960
        12    Anſwer, 22 l. 3 s.          ----
      ----            Pepper.            21168
         0
```

d. ℔. l. s.
2dly, If 15 *d.* $\frac{1}{4}$ buy 1 of Ginger, what will 22 : 3

4 20

61 443

l. 12

61)21264(348+$\frac{36}{61}$. 5316

183:.. Ginger. 4

296 21264

244

524

488 Anſwer 348=$\frac{36}{61}$. Pounds of Ginger, muſt be delivered for the Pepper.

36

Queſt. 2. How much Sugar at 8 *d. per* ℔. may be bought for 20 *C.* of Tobacco, at 3 *l. per* 112 ℔. Weight?

C. *l.* C.
1 of Tobacco 3——— 20
Facit 60.

d. *l.* *s.* *d.*
8 buy 1 ℔. of Sugar, what 60 : 0 : 0

20

l.

8)14400(1800 1200

8.... 12

64 14400

64

00

Anſwer, 1800 Pounds of Sugar.

Queſt. 3. 20 *C.* of Braſil is given for 43 *C.* of Coperas at 8 *s.* *p. C.* what Price muſt each hundred of Braſil bear.

Anſwer, 17 *s.* $\frac{1}{5}$.

Thus found,

```
 43 at 8
  8
 ----            C.               l.   s.       C.
 34|4        If 20 of Braſil——17 : 4 what 1
 ----                              20
 17|4                             ----
 ----                             344

              20)344(17— 4/20|1/5.
                 20
                ----
                 144
                 140
                ----
                   4
                ----
```

Queſt. 4. *A.* hath 100 Pieces of Silks, which are worth but 3 *l.* apiece in ready Money, yet he barters them with *B.* at 4 *l. per* Piece, and at that Rate takes their Value of *B.* in Wools at 7 *l.* 10 *s. per* Hundred, which are worth but 6 Pounds *per C.* in ready Money: The Queſtion will be to know, what Quantity of Wool pays for the Silks, and which of the Two, *A.* or *B.* is the Gainer, and how much?

Anſwer, 53 *C.* $\frac{1}{3}$ of Wools pay for the Silks, and *A.* gaineth 20 Pounds in Money by the Barter.

Thus found,

l. s. l. l.
1. If 7 : 10——become 6 what will 400
Facit 320 *l.*

l. C. l.
2. If 6 ready Money buy 1 of Wool, what 320
ready Money?
Anſwer, 53 C. $\frac{1}{3}$ of Wools.

So it is evident, that the true Weight of the Wool hich *B.* delivered was 320 *l.* for which he recei- d only of *A.* the Worth of 300 *l.* in Silks, and refore *B.* looſeth 20 *l.* by the Barter.

Queſt. 5. When Cinnamon at 4 *s.* ready Money bartered at 5 *s.* and Cotton at 14 *d. per* Yard, is ter'd for the Cinnamon, what muſt the Yard be d for in Barter to looſe 10 *l.* in every 100 *l.*

Anſwer, 15 *d.* $\frac{3}{4}$.

Thus found,

```
         s.            s.          d.
First, If 4 in Barter for 5 what muſt 14
          12            12
          ——            ——
          48            60
          —              4
                        ——
                       240
                        14
                       ———
                       960
                      240
                     ————    4      d.
                  48)3360(70 : 17 1/2.
                     336
                     ———      2
                      00
```

Secondly,

l. l. d.
Secondly, If 100 become 90 what 17 : $\frac{1}{2}$.
Anſwer, 15 *d.* $\frac{3}{4}$.

Queſt. 6. *A.* hath Camblets at 50 *s.* *per* Pie ready Money, which he barters at 3 *l.* to what Pri muſt *B.* raiſe Silk at 21 *s.* *per* ℔. to equal the Barte when he pays $\frac{1}{3}$ ready Money.

s. *s.* *s.* *s.*
60 If 30 —— 40 —— 21
20 ſubtr. 21
40 *s.* 40
80
s.
30)840(28 For Anſwer.
60
240
240
0

Queſt. 7. *A.* barters with *B.* for Cloves at 6 *s.*
7 *s.* 6 *d.* *per* ℔. and loſes 10 *l.* *per Cent.* to have $\frac{1}{3}$ re dy Money, what's the juſt Price of a Yard of Velve delivered at 22 *s.* to equal the Barter?
Anſwer, 18 *s.* : 8 *d.*+$\frac{2}{5}$ of a Penny.

s. *d.*
$\frac{1}{3}$ of 7 : 6
is 2 : 6
reſt 5 : 0

s. *d.*
If 100 looſe 10 what 7 : 6
Anſwer, 9 *d.*

Th

s. *d.*
Then 2 : 6
From 6 : 9

Reſt 4 : 3

s. *s.* *d.* *s.*
If 5——4 : 3——22
12 51

51 22
110

1122

Pence
5)1122(224
2

s. *d.*
12)224(18 : 8 $\frac{2}{5}$.
12
104
96
8

CHAP.

CHAP. XV.

Rebate or Diſcount of Money.

Definition. REBATE is the Payment of much ready Money, in Lieu a Sum due at any Time come, which put forth at tereſt for any ſuch Time, wo become equal to that Sum ſo due at any Time come.

As for EXAMPLE.

Queſt. 1. A Merchant who is to receive 168 at 9 Months End, deſires to have his Money imm diately paid him, for which Courteſy he is will to abate 8 *per Cent. per Ann.* Intereſt; the Queſtio to find how much preſent Money is equivalent 1680 *l.* rebating 8 *l. per Cent.*

The RULE *is,*

As 1 Year or 12 Months, or 365 Days, is to Rate of Intereſt propoſed, ſo is the Time propo the third Term, to find the fourth Number ſough

Months *l.* *Months* *l.*
1. So if 12 ———8———9 *Facit* 6

Th

l. *l.* *l.*
Then if 106 Rebate come from 100 what will 1680

100

168000

l.
$106)168000(1584 + \frac{096}{106}$
106

620
530

900
848

520
424

96

l. *s.* *d*
Anſwer, 1584 : 18 : 6 $\frac{3}{4}$.

s. *d.*
$\frac{96}{106}$ *facit* 18 : 6 + $\frac{3}{4}$

hich ſaid 1584 *l.* 18 *s.* 6 *d.* $\frac{3}{4}$, which is the nt Money the Merchant muſt receive, being deed from 1680. there remaineth the Money red, *viz.*

l. : *s.* : *d.*
95 : 01 : 05 $\frac{1}{4}$

l.	*s.*	*d.*	
1680	00	00	
1584	18	06 $\frac{3}{4}$	Subtract.
95	01	05 $\frac{1}{4}$	Money rebated.

Queſt. 2. How much preſent Money is equi
lent to 3496 Pounds payable at the End of 25 Mont
at the Rate of 6 *l.* Intereſt-Rebate.

l. *s.* *d.*
Anſwer, to receive in preſent Money, } 3107 : 11 : 1+$\frac{1}{3}$

Thus,

Months *l.* *Months* *l.*
1. If 12——6——25 *Facit* 12 :

l. *s.* *l.* *l.*
2*d*, Then if 112 : 10——100——3496
Anſwer, 3107 *l.* 11 *s.* 1 *d.* $\frac{1}{3}$

Queſt. 3. Sold Goods for 795 *l.* 11 *s.* 2 *d.* t
paid at $\frac{2}{3}$ Months, (that is half at three Mon
and the other half at 3 Months after that:) But
Merchant deſiring to be paid for his Goods pre
ly, is content to diſcount at 6 *l. per Cent. per Ann.*

In Queſtions of this Nature you are to di
the given Sum into two Parts, according to the
of Payment.

l. *s.* *d.*
2) 795 : 11 : 2

397 : 15 : 7

Months *l.* *Months* *l.*
1. 12——6——3 *Facit* 1 : 1

l. *s.* *l.* *l.* *s.* *d.*
2. 101 : 10——100——397 : 15 : 7
Facit 391 *l.* 18 *s.*

Then for the ſecond Payment.

Months — *l.* — *Months* — *l.*
12 —— 6 —— 6 *Facit* 3

l. — *l.* — *l.* *s.* *d.*
103 —— 100 —— 397 : 15 : 7
Facit 386 *l.* 3 *s.* 11 *d.*

So that 397 : 15 : 7 for 3 Months — 5 : 17 : 6
397 : 15 : 7 for 6 Months — 11 : 11 : 8

All the Rebate is 17 : 09 : 2

l. *s.* *d.*
Therefore from 795 : 11 : 2
Rebate 17 : 09 : 2

778 : 02 : 0

hus the Money to be paid preſently is 778 *l.* 2 *s.* nſwer.

ueſt. 4. I demand the Diſcount of 760 *l.* 16 *s.* Months after the Rate of 6 *l.* *per Cent.* Simple-eſt.

Thus work,

12 Months be
6 *l.*
Months *l.*
n 4 : — is 2
8 : — is 4 *l.*
12 : — is 6 *l.*

⅓) 760 : 16

253 : 12
253 : 12
253 : 12

760 : 16

l. l. l. s.
1ſt. Then if 102———100———253 : 12

l. s. d.
Facit 248 : 2 : 6 for the firſt Payment
4 Months.

l. l. l. s.
2*d.* If 104———100———253 : 12

l. s.
Facit 243 : 16 for the ſecond Payment
8 Months.

l. l. l. s.
3*d.* If 106———100———253 : 12

l. s.
Facit 239 : 4 for the third Payment
12 Months.

l.	s.	d.	
248	02	6	Firſt Payment.
243	16	0	Second Payment.
239	04	0	Third Payment.
731	02	6	The ready Money to be paid.

	l.	s.	d.	
From	760	16	0	
Subt.	731	02	6	
	29	13	6	To be rebate

l. s. d.
The Anſwer is 731 : 2 : 6 to be paid preſen

Queſt. 5. If 360 *l.* 12 *s.* be payable at the End of 163 Days to come, how much preſent Money ill diſcharge the ſaid Debt by rebating after the ate of 5 *l. per Cent. per Ann.*

Days	*l.*	*Days*
If 365	5	162

l. *s.* *d.*
Anſwer, 2 : 4 : 4 ½.

l. *s.* *d.* *l.* *l.* *s.*
Then, If 102 : 4 : 4 ½ —— 100 —— 360 : 12.

Far.	*Far.*	*Far.*
98128	96000	346176

Multiply and Divide according to Rule,

l. *s.* *d.* *far.*
352 : 15 : 7 : 0 preſent Money to be paid.

ueſt. 6. How much preſent Money muſt be paid oo *l.* payable in this Manner, *viz.*

l.		*l.*
200 at 8 Months	Rebating 8 *per Cent. per Ann.* Simple Intereſt.	
140 at 6 Months		
60 at 2 Months		

l. *s.* *d.*
Anſwer 383 : 13 : 11 + $\frac{11639}{171439}$

Thus,

Months	*l.*	*Months*		*l.*	*s.*	*d.*
12	8	8	*Facit*	5	6	8
12	8	6	*Facit*	4	0	0
12	8	2	*Facit*	1	6	8

Then

Then *per* the Rule of Three.

l.	*s.*	*l.*	*l.*			*l.*	*s.*	
105	6	8	100	200	*Facit*	189	17	
104	0	0	100	140	*Facit*	134	12	
101	6	8	100	60	*Facit*	59	04	

For Anſwer, 383 : 13 : 11

Queſt. 7. How much preſent Money is equi lent to a Rent or Annuity of 100 *l.* a Year continue five Years, rebate being made at Rate of 6 *l.* for 100 *l.* for one Year Simple Inter

					l.	*s.*	*d.*
1	106	100	100	*Facit*	94	06	00
2	112	100	100	*Facit*	89	05	06
3	118	100	100	*Facit*	84	08	00
4	124	100	100	*Facit*	80	12	02
5	130	100	100	*Facit*	76	18	1 ½
					2		
					425	18	09 ½

So that by this Queſtion and others before, manifeſt there muſt be computed the preſent w of 100 *l.* due at the firſt Year's End, alſo the pr Worth of 100 *l.* due at the ſecond Year's End; in like Manner, the third, fourth and fifth Y all which particular preſent Worth being a together, the Sum will be the Total above pounded.

l. *s.* *d.*
Viz. 425 : 18 : 9 ½ very near.

CH

CHAP. XVI.

Simple-Intereſt.

SIMPLE-INTEREST is that which ariſeth or is computed from the Principal only, and here all Queſtions are done by the double *Rule of Three Di-* or the *Rule of Practice.*

As for EXAMPLE.

Queſt. 1: What will the Intereſt of 475 *l.* 11 *s.* 6 *d.* ne to for a Year, at the Rate of 5 Pounds *per* *t.*

```
     l.     l.              l.   s. : d.
If 100 gain 5  what will 475  : 11 : 6
        20                  20
      ----                ----
      2000                9511
        12                  12
     -----              ------
     24000               19022
     =====               9511
                        ------
                        114132
                             5
                        ------
                        570660
```

```
                     l.     s.   d.
24|000)570|(23  :  15  :  6
        48··
        ----
         90
         72
         ----
          18
          20
     24)378(15
          24·
          ----
          138
          122
          ----
           18
           12
          ----d.
     24)216(6:
          216   Anſwer, 23 l. 15 : 6 d
```

The ſame Sum a ſhorter Way by *Practice.*

The RULE.

Multiply the Principal by the Rate of Intere *per Cent. per Annum,* and the Product, (caſting two Figures on the Right-hand) is the Intereſt f one Year, from whence 'tis found for any Ti required.

Thus,

l. *s.* *d.*
475 : 11 : 06 } multiply.
5 }

---

23 | 77 : 17 : 06
| 20

---

15 | 57
| 12

---

6 | 90

Queſt. 2. What is the Intereſt of 571 *l.* 15 *s.* for
Months at 6 *l. per Cent. per Ann.*

By the Double Rule of Three Direct.

l. *l.* *l.* *s.* *d.*
If 100 —— 6 —— 571 : 15 : 0

l. *s.* *d.*
Anſwer, 34 : 6 : 1

Months *l.* *s.* *d.* *l.*
Then if 12 —— give 34 : 6 : 1 —— what will 8

l. *s.* *d.*
Anſwer, 22 : 17 : 4 ¾.

Queſt. 3. How much Money will 567 *l.* 10 *s.*
me to in nine Years after the Rate of 6 *l. per Cent.*
mple-Intereſt?

l. *s.* *d.*
Anſwer 306 : 9 : 0

Thus,

l. *l.* *l.* *s.*
100——6——567 : 10

l. *s.* : *d.*
Facit 34 : 1 : 0

Then,

Year *l.* *s.* *d.* *Years:*
If 1 gain——34 : 1 : 0——what will 9

l. *s.* *d.*
Facit 306 : 9 : 0

Queſt. 4. What Principal or Sum of Mone being put out to Intereſt for 9 Years will amoun unto, or raiſe a Stock of 873 *l.* 19 *s.* at 6 *l.* *per Ce* *per Ann.*

l. *s.*
Anſwer 567 : 10

Thus,

Year *l.* *Years*
1——6——what will 9

Anſwer, 54 *Pounds.*

l. *l.* *l.* *s.*
If 154——100——873 : 19

Anſwer, 1135|0 *Shill.*

l. *s.*
Anſwer, 567 : 10 567|10

Queſt. 5. Suppoſe a Debt of 873 *l.* 19 *s.* were ot to be paid until 9 Years hence, what would it worth in ready Money, the Creditor allowing e Rate of 6 *l. per Cent.* Diſcount to the Debitor?

l. *s.*
Anſwer, 567 : 10

Queſt. 6. At what Rate of Intereſt *per Cent.* will 67 *l* 10 *s.* raiſe a Stock, or amount to 873 *l.* 19 *s.* 9 Years Time.

l. *s.* *l.* *s.* *l.*
If 567 : 10 gain 306 : 9 Intereſt what will 100
reduced into Shillings.

108|0 *Shill.*

Will make 54 *l. Int.*

Years *l.* *Year*
Then if 9 come to —— 54 —— what will 1

l. *l.*
9)54(6 Anſwer, 6

Queſt. 7. Again, In what Time will 567 *l.* 10 *s.* mount unto or raiſe a Stock of 873 *l.* 19 *s.* at 6 *l.* *er Cent. per Ann.*

Anſwer 9 Years.

Thus found,

l. *l.* *l.* *s.*
If 100 gain —— 6 —— what will 567 : 10
Reduced to Shillings are $\frac{68100}{2000}$.
l. *s.*
34 : 1
Which 68100 Shillings divided by 2000.

2000)

l. s.
2000)68100(34—$\frac{100}{2000}$ l.=1
6000
8100
8000
100

Then to find the Years ſay,

l. s. Year l. s.
If 306 : 9 require 1 ——what will 34 : 1
20 20
6129 681

681)6129(9 Years for Anſwer:
6129
0

NOTE *well*,

If the Work of theſe four laſt Examples, *viz.* Queſtion the third, fourth, fifth and ſixth Examples, and the Rules by which they are performed, be well underſtood, they will be ſufficient (notwithſtanding there is really but one Queſtion, only they are varied according to the ſeveral Caſes) to ſhew how any Queſtion of the like Kind may be truly reſolved at any propoſed Rate of *Simple-Intereſt*, eſpecially if the Time given or ſought does conſiſt of commplete or whole Years. But if the Time given or ught, does not conſiſt of whole Years, as moſt generally it does not, it being either leſs than a Year more; then the *Double Rule of Three Direct* perms thoſe Queſtions much more eaſily and plainly, an any Operation; as ſhall appear in the following Pages.

Queſt. 8. What comes the Intereſt of 192 *l.* 14 *s.* *d.* too for 830 *Days*, at 5 *l. per Cent. per Ann.*

l. *s.* *d.*
Anſwer, 25 : 11 : $3 + \frac{13}{73}$.

Thus, Firſt;

l. —— *l.* —— *l.* *s.* *d.*
100 ——— 5 ——— 192 : 14 10

l. *s.* *d.*
Facit 2698 *Pence*, or 11 4 $10 + \frac{9}{24}$.

Then,

Days —— *Pence* —— *Days*
If 365 ——— 2698 ——— 830

l. *s.* *d.*
Facit 6135 *Pence*, or 25 : 11 : $3 + \frac{68}{365}$.

l. *s.* *d.*
Anſwer, 25 : 11 : $3 + \frac{65}{365} | \frac{13}{73}$.

Queſt. 9. What is the Intereſt of 1000 *l.* put to the Bank of *England*, and taken out at 146 D Time, at 5 *per Cent. per Ann.*

l.
Anſwer, 20

l. ——— *l.* ——— *l.*
100 ——— 5 ——— 1000

l.
Anſwer, 50

Days ——— *l.* ——— *Days*
365 ——— 50 ——— 146

Anſwer, in Pence 4800, which is in Sh lings 400 *s.* and in Pounds 20 *l.*

Queſt. 10. I demand the Intereſt of 572 *l.* f 75 Days at 5 *l. per Cent. per Ann.*

l. *s.* *d.*
Anſwer, 5 : 17 : 6 + $\frac{150}{365}$.

l. ——— *l.* ——— *l.*
100 ——— 5 ——— 572

$$\begin{array}{r} 572 \\ 5 \\ \hline 2860 \\ \hline \end{array}$$

1|00)28|60

l. *s.*
Anſwer, 28 + $\frac{60}{100}$ or 12

Da

```
Days          l.   s.              Days
365-----------28 : 12--------------75
              20
             ----
             572
              12
            -----
            1444
            572
           ------
            6864
              75
           ------
           34320
          48348
         ------------ 12
   365)514800(1410(11|7
         ....  ... --.|--
          150    6   5|17 : 6 + 150/365.
         ------ --
```

C H A P.

CHAP. XVII.

Compound-Intereſt.

COMPOUND-INTEREST, or *Inte* upon *Intereſt*, increaſeth not only fr the Principal, but alſo from the Inte thereof.

This Sort of Intereſt is commonly worked *Decimal Arithmetick*.

But for the better underſtanding of it, I ſh ſtate a few Queſtions to be performed by *Vulg Arithmetick*.

As for EXAMPLE.

Queſt. 1. So if 300 *l.* be put out at 6 *l.* *per C per Annum*, reckoning Intereſt upon Intereſt, wh what is the Money I muſt receive then ?

l.		*l.*
300	at	6 *per Cent.*
6		
18|00		

l.	*s.*	*d.*	
300	00	00	Principal.
18	00	00	Intereſt.
318	00	00	Increaſe the fi Year.

l. *s.* *d.* *l.*
318 : 00 : 00 at *6*
6

19|08 : 00 : 00
|20

1|60
|12

l. *s.* *d.*
7|20 318 : 00 : 00
| 4 19 : 01 : 07

0|80 337 : 01 : 07 Increaſe the 2d Year.

l. *s.* *d.* *l.*
337 : 01 : 07 at *6 per Cent.*
6

0|22 : 09 : 06
|20

4|49
|12

l. *s.* *d.*
5|94 337 : 01 : 07
4 20 : 04 : 05 ¾

3|76

357 : 06 : 00 ¾ Increaſe Third.

l. *s.* *d.* *l.*
357 : *06* : 00 $\frac{3}{4}$ at *6 per Cent.*
6

21|43 : 16 : 04 $\frac{1}{2}$
|20

8|76
|12

9|16
|4

0|*66*

l. *s.* *d.*
357 : *06* : 00 $\frac{3}{4}$
21 : 08 : 09

378 : 14 : 09 $\frac{3}{4}$ Fourth Ye

So that at the fourth Year's End he muſt rece
for Principal and Intereſt 378 *l.* 14 *s.* *9 d.* $\frac{3}{4}$.

This Way of Operation is a briefer or more co
pendious Way than by the *Rule of Three,* which w
prove very tedious.

Firſt State your Queſtion as before.

If 100 gain *6* what will 300 your Principal.

Multiply firſt your Principal by your Intereſt,
done cut of the two firſt Figures towards y
Right-hand of the Pounds with a Line.

Then multiply them by 20, 12, and 4, and
above two Figures towards your Right-hand, c
over the Line to the Left, as you ſee in this
Example.

A

A few Examples to thoſe who underſtand the *Rule of Practice*, it will prove eaſy.

A ſecond Example ſhall be this,

What comes the Intereſt of 2456 *l.* 10 *s.* at 5 *l.* *per Cent.* for three Years, reckoning Intereſt upon Intereſt.

l. *s.* *d.* *l.*
2456 : 10 : 00 at 5 *per Cent.*
5

122|82 : 10 : 00
|20

16|50
|12

6|00

l. *s.* *d.*
2456 : 10 : 0 Principal.
122 : 16 : 6 Intereſt.

2579 : 06 : 6 Increaſe the firſt Year.

l. *s.* *d.*
2579 : 06 : 06 at 5
5

128|96 : 12 : 06
|20

19|32
|12

3|90
|4

3|60

l. *s.* *d.*
2579 : 06 : 06
128 : 19 : 03 $\frac{3}{4}$

2708 : 05 : 09 $\frac{3}{4}$
Increaſe the ſecond Year.

l. *s.* *d.* *l.*
2708 : 05 : 09 ¾ at 5
5

135|42 : 09 : 00 : ¾
|20

8|49
|12

5|88
|4

3|55

l. *s.* *d.* *far.*
2708 : 05 : 09 : 3
135 : 08 : 05 : 3

2843 : 14 : 03 : ½
Increaſe the third Yea

So that he muſt receive at the third Yea
2843 *l.* 14 *s.* 3 *d.* ½.

Queſt. 3. What comes the Intereſt of 1920 *l.* 17 for 8 Years, reckoning Intereſt upon Intereſt at 6 *l.* *per Cent.*

l. *s.* *l.*
1920 : 17 at 6 *per Cent.*
6

115|25 : 02
|20

5|02
|12

0|24
|4

|96

l. *s.*
1920 : 17 Principal
115 : 05 Intereſt.

2036 : 02 Increaſe
first Year.

2036

l. s. l.
2036 : 02 at 6 per Cent.
6

22|16 : 12
|20

3|32
|12

3|84
|4

3|36

l.	s.	d.	
2036	02	00	Principal.
122	03	03 ¾	Intereſt.
2158	05	03 ¾	Increaſe ſecond Year.

l. s. d.
2158 : 05 : 03 ¾ Principal.
6

129|42 : 11 : 10 ½
|20

9|91
|12

11|02
|4

0|10

l.	s.	d.	
2158	05	03 ¾	Principal.
129	09	11	Intereſt.
2287	15	02 ¾	Increaſe third Year.

l. *s.* *d.*
2287 : 15 : 02 ¾ At *6 per Cent.*
6

137|26 : 11 : 04 ½
|20

5|31
|12

3|76
|4

3|06

l. *s.* *d.*
2287 : 15 : 02 ¾ Pri
137 : 05 : 03 ¾ In

2425 : 00 : 06 ½
Increaſe 4th Year.

l. *s.* *d.*
2425 : 00 : *06* : ½ at *6 per Cent.*
6

145|50 : 03 : 03 : 0
|20

10|03
|12

0|39
|4

1|56

l. *s.* *d.*
2425 : 00 : *06* : ½ Principal.
145 : 10 : 00 : ¼ Intereſt.

2570 : 10 : *06* : ¾
Increaſe the 5th Year.

l. *s.* *d.* *l.*
2570 : 10 : 06 : ¾ at 6 *per Cent.*
6

154|23 : 03 : 04 : ½
|20

4|63
|12

7|60
|4

2|40

l. *s.* *d.*
2570 : 10 : 06 : ¾ Principal.
154 : 04 : 07 : ½ Intereſt.

2424 : 15 : 02 : ¼
Increaſe the 6th Year.

l. *s.* *d.* *l.*
2724 : 15 : 02 : ¼ at 6 *per Cent.*
6

163|48 : 11 : 01 : ½
|20

9|71
|12

8|53
|4

2|14

l. *s:*
2724 : 15 : 2 : ¼ Principal.
163 : 09 : 8 : ½ Intereſt.

2888 : 04 : 10 : ¾ Increaſe 7th Year.

```
 l.      s.    d.        l.
2888 : 04 : 10 : ¾ at 6 per Cent.
                 6
_______________________________

173|29 : 09 : 04 : ½
   |20
---|----
  5|89
   |12
---|----          l.     s.    d.
 10|72          2888 : 04 : 10 : ¾ Principal.
   | 4           173 : 05 : 10 : ½ Intereſt.
---|            ____ ____ ____ __
  2|90          3061 : 10 : 09 : ¼ Increaſe the 8
_______         ________________Year.
```

Thus you find that the Sum of 1920 *l.* 17 *s.* p out at Intereſt upon Intereſt at 6 *l.* *per Cent. per A* for 8 Years, amounts to 3061 *l.* 10 *s.* 9 *d.* ¼. a how it amounts to each Year, you may ſee yea from the working of the Queſtion.

Thus much for *Simple* and *Compound-Intereſt*, t we come to *Decimal Arithmetick.*

CHA

CHAP. XVIII.

EXCHANGE.

THE whole Buſineſs of the Exchange of Coins from one Country to another, it is neceſſary that the *Par* or Value of the Money in each Place be exactly known, the riſing, falling, and debaſing of the ſame, is ubject unto Change, Examples whereof you ſee *rance*, and other Countries ; ſo that of Neceſſity Merchant by knowing daily upon the *Exchange*, the Equality or *Par* of Coins riſeth or falleth ; may by the *Rule of Three*, or the *Rule of Pra-* work any Queſtion, I ſhall therefore give you Queſtions, and ſo leave you to enlarge as you find Occaſion.

As for EXAMPLE.

Merchant delivered 530 *l. Sterl.* in *London*, at *per l.* to receive the ſame by a Bill of Exchange *mſterdam*, the Exchange at thirty-three Shillings our Pence *Flemiſh*, for a Pound Sterling, I demand ſame in *Flemiſh* Money.

NOTE, That in the ſtating of your Queſtion, firſt, and third Numbers muſt be both of one d; if the firſt be *Sterling* Money, the third muſt

be *Sterling*; if the firſt be *Flemiſh*, the third muſ
Flemiſh.

Queſt. 1. If 20 *s. Sterling* give 33 *s.* 4 *d.* w
will 530 *l. Sterling?*

```
  s.             l.  s.               l.
If 20————————————33 : 4———————————————530
                 12                    20
                ———                  ————
                400                 10600
              —————                   400
                                  ———————
                                  4240000
                 12               ———————
20)4240000(212000(1766|6
   40·····  12·····————————
   ——       ——      883|6 : 8
   24       92      ————————
   20       84
   ——       ——
    40       80
    40       72
    ——       ——
     0        80
    ——        72
              ——
               80
               72
               ——
                8
               ——
```

Anſwer, *Flem.* 883 *l.* 6 *s.* 8 *d.*

Or thus ſhorter.

```
   l.        s.   d.
3)530 at 33 : 4
   33
  ----
  1590
 1590
 -------
 17490
   176 : 8
 ---------
 1766|6 : 8
 ----|-----
  883|6 : 8
 ----------
```

ueſt. 2. If I deliver in *Antwerp* 7110 *l.* 16 *s.* *miſh*, the Exchange at 27 *s.* 8 *d.* ½ *Flemiſh per* *s. Sterling*, what Money *Sterling* ſhall be received *ondon*, when the Exchange is as above.

Thus by the Rule of Three Direct.

s. d. s. l. s.
f 27 : 8 ½ produce 20 *Sterl.* what 7110 : 16 *Flem.*

nd by the Work you will find it to make 32 *l.* 12 *s.*+$\frac{100}{665}$ received in *London.*

PROOF.

PROOF.

By Converſion.

l. *s.* *d.* *s.* *d.*
$\frac{2}{3}$)5132—12—1 at 27—8 $\frac{1}{2}$ *Fle*
27

35924 8 *d.* $\frac{2}{3}$ *s.*
10264 $\frac{1}{2}$ $\frac{1}{8}$ of 4 *d.*

10 *s.* $\frac{1}{2}$ 138564
Price 1710—08
2 *s.* $\frac{2}{10}$: 10 *s.* 8)1710—08
1 *d.* 12 : 1 *s.* 213—10
13—10—$\frac{1}{4}$
1—04—$\frac{1}{2}$
1—04—0 Mites
0—01—$\frac{1}{4}$ - 3 - $\frac{3}{12}$ = $\frac{1}{4}$

14221 | 5—10—$\frac{3}{4}$—3—$\frac{1}{4}$

7110 | 15—10—$\frac{3}{4}$—3—$\frac{1}{4}$

Queſt. 3. At what Rate went the Exchange f *London* to *Rotterdam*, when I deliver 700 Pounds S *ling* in *London*, and receive in *Rotterdam* 1010 *Flem*

l. *l.* *s.*
If 700 *Sterl.* make 1010 *Flem.* what 20 *Sterl.*

l. *s.* *d.*
Facit per Rule of Three 1 : 8 : 10 :

PRO

PROOF.

l. *l.* *s.* : *d.*
700 at 01 : 08 : 10 $\frac{1}{4}$
1

(*Sterl.*

	l.	*s.*	*d.*		
$\frac{2}{5}$)	700	00	00	00	8 *s.* $\frac{2}{5}$ of a Pound
	140	00	00	00	6 *d.* $\frac{1}{8}$ of 4 *s.*
8)	140	00	00	00	3 *d.* $\frac{1}{2}$ of 6 *d.*
8)	17	00	00	00	1 *d.* $\frac{1}{2}$ $\frac{1}{2}$ of 3 *d.*
2)	8	15	00	00	$\frac{1}{4}$ $\frac{1}{6}$ of 1 *d.* $\frac{1}{2}$
	4	07	06	00	
	0	14	07	00	
	1011	07	01	00	Small Diff.

ſt. 4. How many Dollars at 4 *s.* 4 *d.* *per* ſhall I give for 9010 *Sterling* in *Flanders*?

Therefore,

d. *l.*
: 4 *Sterl.* make 1 Dollar, what will 9010 *Sterl.*

20
180200
12
2162400

52)

```
52)2162400(41584 Dollars 32/52.
   208·····
   ---
    82
    52
    ---
    304
    260
    ---
     440
     416
     ---
      240
      208
      ---
       32
      ---
```

Anſwer, 41584 Dollars $\frac{32}{52}$ at 4 *s.* 4 *d.* muſt b
livered in *Flanders* for 9010 *l. Sterling.*

Queſt. 5. How much *Sterling* muſt I pay he
London to receive in *Hamburgh* 836 *l.* 8 *s.* 4 *d.* Fl
Exchange at 36 *s.* 8 *d. Flem. per* 20 *s. Sterling?*

Thus,

```
   s.   d.           s.             l.    s.
If 36 : 8——make 20 Sterl.——836  :  8 : 4
```

Reduced.

```
Pence         Pence          Pence
 440————————240————————200736
                             440
                      ———————————
     Product is       48176640
                      ———————————
```

```
                  12
440)48176640(109492(912|4
    440 ....    108 ....   ----|----
    ----        ----        456|4 : 4 : 4/11.
    4176        14         -----------------
    3960        12
    ----        ----
    2166        29
    1760        24
    ----        ----
    4064        52
    3960        48
    ----        ----
    1040         4
     880        ----
    ----
     160
    ----
```

nſwer, 456 *l.* 4 *s.* 4 *d.* $\frac{4}{11}$ he muſt deliver in *don.*

ueſt. 6. If 35 Ells at *Vienna* make 24 Ells at *s*, 3 Ells of *Lyons* 5 Ells of *Antwerp*, and 100 of *Antwerp* 125 Ells at *Franckfort*, how many of *Vienna* are equal unto 50 Ells at *Franckfort*?

Anſwer, 35.

Suppoſitions 35 *A.* = 24 *B.*
3 *B.* = 5 *C.*
100 *C.* = 125 *D.*
50 *D.* = *A.*

35	24
3	5
100	125
50	
25000	)15000

The Rule, Multiply all the given Terms, which ſtand in the firſt Column, by continual Multiplication, and let that be your Dividend.

15000)525000(35
45000..

75000
75000

00

Anſwer 35 Ells of *Vienna* as was required.

Again, multiply all the gi Terms which ſtand in the cond Column by contin Multiplication, and let t Product be your Diviſ and the Quotient is y Anſwer.

35	24
3	5
105	120
100	125
10500	600
50	240
	120
525000 Dividend.——	——Divi
	15000

Queſt. 7 If 16 *l.* of *Avoirdupois* Weight at *Lon* be equal to 9 ℔. of *Amſterdam*, 45 of *Amſterd* 49 ℔. at *Bruges*, and 98 ℔. at *Bruges*, equal to 1 ℔. at *Dantzick*; how many Pound of *Dantz* are equal to 112 ℔. of *Avoirdupois* Weight *London.*

Soppoſitions	10 *A.* = 9 *B.*	10	9
	45 *B.* = 49 *C.*	45	49
	98 *C.* = 116 *D.*	98	116
Queſt.	112 *A.* = *D.*		112

Anſwer, 129 ℔. $\frac{92}{100}$ *Dantzick.*

The R U L E.

Multiply all the given Terms which ſtand in t latter Column, and the laſt odd Term in the f Place by continual Multiplication, and make it y Dividend.

Ag

Again, multiply continually the reſt of the Terms ich ſtand in the firſt Column, and make it your viſor; ſo the Quotient is your Anſwer.

10	9
45	49
50	441
40	116
50	2646
98	441
	441
00	51156
	112
o Diviſor.	
	102312
	51156
	51156

44100)5729472(129 + $\frac{92}{100}$ ℔. of *Dantzick.*

CHAP. XIX.

Alligation-medial.

1. THE *Rule of Alligation* is that
which we reſolve Queſtions, t
concern the mixing of divers S
ples together.

2 *Alligation* is either *Medial* or *Alternate.*

3. *Alligation Medial* is, when having the ſe
Quantities and Rates of divers Commodities p
pounded, we diſcover the mean Rate of a M
ture compounded of thoſe Commodities.

Queſt. 1. So 5 Buſhels of Wheat at 2 *s.* 8
Buſhel, 9 Buſhels of Rye at 2 *s. per* Buſhel, I w
know how much the Buſhel ſo mixed would ſ
him in, the one with the other?

The Operation.

To work this Rule, multiply every Commo
by his Price, and add all the Products together,
make it your Dividend: Then add up all the Q
tities together which your Mixture was comp
of, and that Product make your Diviſor, and
Quotient is your Anſwer to the mean Rate or
of that Part.

Repe

Repeating again the aboveſaid Example, I demand ow much that Miſtling is worth?

Thus according to Rule.

```
s.  d.            s.              s.  d.
2 : 8             2               13 : 4
5                 9               18 : 0 add.
------          -----             -------
13 : 4            18              31 : 4
------          -----             12 : 0
         5 Buſhels of Wheat.      -------
         9 Buſhels of Rye.        376 Dividend
       -----add
        14 Diviſor.
       -----
```

Then 376 divide by 14:   Anſwer, 2 *s.* 2 *d.* $\frac{3}{4}$.

```
         12 s.   d.
14)376(26(2  :  2+12/14
   28..  24.
   ---   ---
    96    2
    84   ---
   ---
    12
```

2+$\frac{12}{14}$ or $\frac{6}{7}$; ſo that I conclude that a Buſhel of that Miſtling may be afforded for 2 *s.* 2 *d.* $\frac{6}{7}$, or $\frac{1}{3}$ *farth.* is the Reſolution of the Queſtion propounded.

The PROOF.

n *Alligation-medial* the Trial of the Work is by paring the total Value of the ſeveral Simples, h the Value of the whole Mixture; and when ſe Sums agree, the Operation is perfect, ſo in Example.

s. : d.
5 Buſhels of Wheat at 2 *s.* 8 *d.* is ——13 : 4 } add.
9 Buſhels of Rye at 2 *s.* —— ——18 : 0 }

All which amount unto—— 31 : 4

which is likewiſe the Value of 14 Buſhels of Whe
at 2 *s.* 2 *d.* + $\frac{3}{4}$.

For by the Rule of Three.

If 1 Buſhel coſt 2 *s.* 2 *d.* + $\frac{3}{4}$. what will 14 Buſhe
Anſwer, 31 *s.* 4 *d.* with the Fraction $\frac{6}{7}$. or $\frac{3}{4}$ *far*

Queſt. 2. A Grocer hath 27 *l.* Weight of larg Cloves, at 6 *s. per* ℔. 15 ℔. of the middle Sort 2 *s.* 6 *d. per* ℔. and 10 ℔. of worſer Sort at 2 *s.* 2 mix theſe together, and how ſhall I ſell it then b the Pound.

℔. s.	℔. s. d.	℔. s. d.
27 at 6 *p.* ℔	15 at 2 : 6 *p.* ℔.	10 at 2 : 2 *p.*
6	2	2
16|2	30	20
8|2	7 : 6	1 : 8
	3|7 : 6	2|1 : 8
	1|17 : 6	1|1 : 8

	l.	*s.*	*d.*	℔.
Add	8	2	0	27
	1	17	6	15
	1	1	8	10
Facit	11	1	2	52 Diviſor.
	20			
ll.	221			
	12			
ce	2654 Dividend			

12
52(2654(51(4 : 3 + $\frac{1}{26}$.
260·· 48
54 3
52
2

Anſwer, He muſt ſell the Cloves ſo mixt, for 4 *s.* 3 *d.* $\frac{1}{26}$ *per* ℔.

ueſt 3. A Goldſmith hath 8 ℔. Weight of Silver ion of 7 *oz.* fine, 15 ℔. of 8 *oz.* $\frac{1}{2}$ fine, and 13 ℔. o Ounces fine, and he would melt all together, and what Fineneſs a Pound Weight of that Maſs ld come to?

℔. *oz.*	℔. *oz.*	℔. *oz.*
8 of 7	2) 15 of 8 : $\frac{1}{2}$	13 of 10
7	8	10
6	120	130
	7 : $\frac{1}{2}$	
	127 : $\frac{1}{2}$	

Add	56	8
	127 ½	15
	130	13
	313 ½	36
	2	2
	627 Dividend	Divisor 72

	oz.		*pwt.*	*gr.*
72)627(	8 + $\frac{51}{72}$ or $\frac{17}{24}$ makes		14 :	4
576				
51				

Anſwer, 8 *oz.* 14 *pwt* 4 *grains* the Maſs muſt

Queſt. 4. A Merchant having ſeveral Sorts Cloth is deſired to fix a Price, how to ſell one with another, now what Price ought he to ſet the following Parcels, that he may neither loſe gain above the Prices?

Ells		*s.*	*d.*		*s.*	*d.*	
30	at	5 :	0	*per* Ell is	150 :	0	add.
35	at	7 :	*6*	*per* Ell is	262 :	*6*	
40	at	*9* :	0	*per* Ell is	360 :	0	
60	at	12 :	*6*	*per* Ell is	750 :	0	

Then if 165 Ells give —— 1522 : *6* what

12

Dividend 18270 Pence.

Ells
30
35
40
60

165 Diviſor

12 *s.* *d.*
165)18270(110(9 : $2+\frac{3}{4}$ very (near.
165 108
177 2
165
120

$\frac{120}{165} \Big| \frac{24}{33} = \frac{3}{4}$ fere.

Anſwer he muſt ſell it for 9 *s.* 2 *d.*$+\frac{3}{4}$.

Queſt. 5. A Vintner having 24 Gallons of Canary 8 *s. per* Gallon, 16 Gallons of Claret at 4 *s. per* llon, 42 Gallons of Rheniſh Wine at 6 *s per* Gal-, and 12 Gallons of Palm-Wine at 16 *s. per* Gal-, how may he ſell theſe together that he may not e?

Gallons	*s.*	*Shill.*
24 at	8 is	192
16 at	4 is	64
42 at	6 is	252
12 at	16 is	192

If 94 Gallons. 700 Shill. what 1 Gallon.
Diviſor 12

8400 Dvidend.

12 s. d.
94)8400(89(7 : 5 $\frac{1}{4}$
752 84
880 5
846
34

Anſwer, 7 s. 5 d. $\frac{1}{4}$.

Queſt. 6. An Hoſtler mixed Provender for Horſ
viz.

	s.	d.		s.
5 Buſhels of Oats	3 :	6	*per* Buſhel, is	17 :
3 Buſhels of Oats	4 :	8	*per* Buſhel, is	14 :
2 Buſhels of Malt	2 :	2	*per* Buſhel, is	4 :
4 Buſhels of Beans	5 :	3	*per* Buſhel, is	21 :
14 Buſhels				56 :
4				12
56 Pecks			Pence	682

If 56 Pecks give 682 Pence, what will 1 Peck.

d.
56)682(12+$\frac{10}{56}$ or $\frac{5}{28}$th of a Penny.
56
122
112
10

He muſt ſell it for 12 d $\frac{5}{28}$ a Peck.

CHAP. XX.

Alligation-alternate.

DEFINITION.

ALligation-alternate is, when having the ſeveral Rates of divers Simples given, we diſcover ſuch Quantities of them, as are neceſſary to make a Mixture, which bear a certain Rate propounded.

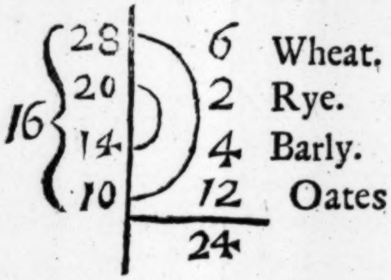
The right ordering of the Terms.

irſt you muſt ſet down the Numbers of which will make the *Alligation*, orderly one under the r: and the common Number, whereinto you t reduce them, ſet on the Left-hand. Then e, which of the ſaid Numbers are leſſer than common Number, and which of them be ter, and with a Draught of your Pen link two mbers together; ſo that the leaſt Number may ill linked with the greateſt, and the greateſt with ſmalleſt.

hen add up all theſe Differences into one Total, ch ſhall be the firſt Number in the *Rule of Three*, the ſecond Number the common Number, then Third muſt be each Difference done by itſelf.

As for EXAMPLE.

Queſt. 1. A Man being determined to mix Whe at 28 *d*, *per* Buſhel, Rye at 20 *d* Barley at 14 *d.* a Oats at 10 *d.* *per* Buſhel, are to be mixed, as Buſhel of the Mixture may be ſold for 16 *d.* Ther fore drawing a Line of Connexion, I place



Having ranked the Terms in their due order such Sort, that one, that is greater than the Root Order of the Mixture, may always be coupl with another that is Leſs than the ſame; the who Fabrick of the Work, as the Branches are thus linke will ſtand as in this Example.

Then according to Rule.

Buſh. *Buſh.* *Buſh.*
1ſt If 6 of Wheat give 2 of Rye, what 10 of Whe

Facit 3 $\frac{1}{3}$.

Buſh. *Buſh.* *Buſh.*
2d, If 6 of Wheat give 4 of Barley, what 10 of Whe

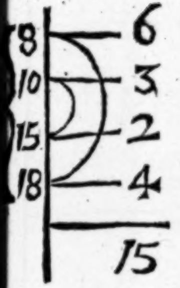
Facit 6 $\frac{2}{3}$.

Buſh. *Buſh.* *Buſh.*
3. If 6 of Wheat give 12 of Oats, what 10 of Whe

Facit 20.

Queſt. 2. A Vintner hath 4 Sorts of Low-Wine four ſeveral Prices, the firſt at 8 *d. per* Gallon, ſecond at 10 *d. per* Gallon, the third at 15 *d.* Gallon, and the 4th at 18 *d. per* Gallon: Now he uld mix all theſe Sorts together, that a Gallon theſe (lower or decayed) Wines may be worth *d.* the Puncheon holding 84 Gallons.

Then



Gall.
If 15——84——6

Facit 33 + 3/5 of the firſt Sort.

Gall.
If 15——84——3

Facit 16 + 4/5 of the 2d Sort.

Gall.
If 15 give ——84——what will 2

Facit 11 + 1/5 of the 3d Sort he muſt take.

Gall.
If 15 give ——84——what will 4

Facit 22 + 2/5 of the 4th Sort.

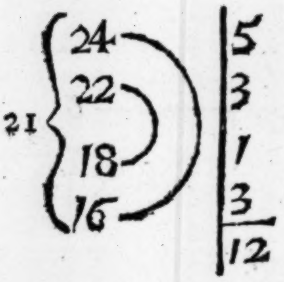
Which ſaid Quantities added up make 84, *viz.*

	Fractions
33	
16	3
11	4
22	1
2 add	2
84 for Proof.	2 *facit*.

5)10(2 for Fractions.

Queſt. 3. A Goldſmith hath divers Sorts of Gold, *viz.* ſome of 24 Carrects, others of 22 Carrects, others of 18 Carrects, and others of 16 Carrects fine, is deſirous to melt as much of all these four Sorts together, as may make a Maſs of Gold to contain 60 Ounces of 21 Carrects fine?

Then



If 12———oz. 60———5

Facit 25 Ounces of the

If 12———oz. 60———3

Facit 15 Ounces of the

If 12———oz. 60———1

Facit 5 Ounces of the 3d.

If 12———oz. 60———3

Facit 15 Ounces of the 4th.

Which ſaid Quantities ſo taken and mix'd, make up the Maſs of 60 Ounces of 21 Carrects fine.

Viz.

25	Ounces of the firſt Sort.
15	Ounces of the ſecond.
5	Ounces of the third.
15	Ounces of the fourth.
60	Ounces of 21 Carrects fine.

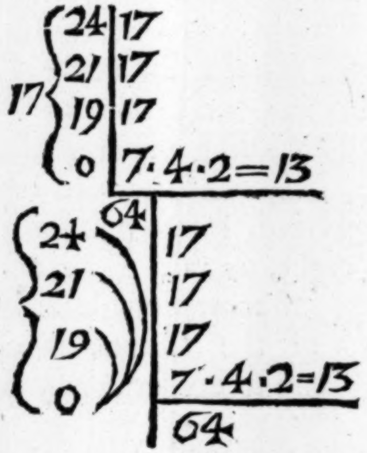
Queſt. 4. A Refiner hath ſome Gold of 24 Carrects ,other of 21 Carrects fine, and others of 19 Carrects, ich he would ſo mix, that 192 Ounces of the in- Mixture might bear 17 Carrects fine. Now the eſtion is, how much of each ſort, as alſo how h Alloy he muſt take to accompliſh his Deſire.

Note, Before you can well underſtand this Que- n, it will be very neceſſary to know what you an by a Carrect fine, and what Alloy is: The Re- rs and Goldſmiths, to diſtinguiſh the different neſs of Gold, eſteem an intire Ounce to con- 24 Carrects, and one Ounce of Gold that being d in the Fire by loſing nothing of the Weight, is emed by the Mint-Maſters to be 24 Carrects; if after being tried, loſeth one four and twentieth of the Weight, is ſaid to be 23 Carrects fine: ike Manner, that which loſeth two four and tieth Parts of the Ounce is eſteemed to be arrects fine, and ſo conſequently of the reſt.

nd as for what they call Alloy, it is Silver, Cop- or ſome other baſer Metal, with which the ners uſe to mix their Gold, to the Intent they make or abate the Fineneſs thereof.

ere you muſt alſo take Notice, That as the Fine- of Gold is meaſured by Carrects, ſo is the Fineneſs lver eſtimated by Ounces; in ſuch Sort, that a d of Silver, which being tried a certain Time e Fire, and by loſing nothing of the Weight, is to be 12 Ounces Fine: But a Pound that being loſeth ſomewhat of the Weight, is ſaid to be emainder of the Weight fine: As for Example, ound of Silver, that loſeth in the Fire one Ounce, nnyweight, is eſtimated to be 10 Ounces, 12 y-weight fine, and that which loſeth two Ounces, nnyweight, 10 Grains, is ſaid to be 9 Ounces, ennyweight, 14 Grains fine, *&c.*

Now to rank the Terms of this laſt mentio
Queſtion, as alſo the Differences of the Terms
their due order; becauſe the three given Branc
(*viz.* 24 Carrects, 21 Carrects, and 19 Carrects are
greater than 17 Carrects the Root, or Rate of
Mixture; I therefore add O as another Bran
which is leſs than the Root, then the whole fra
of the Work will ſtand as followeth;



Then if,

oz. oz. oz. — oz: oz. oz
64——192——17 64——192——1

Facit 51 Ounces. *Facit* 51 Ounce

oz. oz. oz.
64——192——17 If 64——192—what wil

Facit 51 Ounces *Facit* 39 Ounces.

So that you muſt mix 51 Ounces of every
with 39 Ounces, and it will make 192 Ounces fin

For,

oz.
51
51
51
39

Facit 192 Ounces.

And therefore for Concluſion, I ſay, that 51
unces of Gold, 24 Carrects fine, 51 Ounces of
Carrects fine, 51 Ounces of 19 Carrects fine, and
Ounces of Alloy being all mixed together will
oduce a Maſs of 192 Ounces of Gold, of 17 Car-
ts fine, which is the Satisfaction of the Queſtion
emiſed.

CHAP. XXI.

The *Rule of Falſe or Single Poſitio*

DEFINITION.

THIS Rule is called the *Rule of Falſe*, *Rule of Poſition*, becauſe any Numb is taken for to work the Queſtion b and placed inſtead of the Numb ſought after the Poſition, wherefore you Queſti according to the Tenor thereof; and if your Poſiti happen to be true, then you have ſatisfied the Q ſtion: But if you have taken your Poſition falſe (fr whence it is called the *Rule of Falſe Poſition*) th the true Number is found out by this Rule, of wh there are two Kinds, Firſt, the *Single Rule*, S condly, the *Double Rule*.

The *Rule of ſingle Poſition* is to be uſed, when once, *viz.* by one falſe Poſition we have Means diſcover the true Reſolution of the Queſtion p pounded.

As for EXAMPLE.

Queſt. 1. Three Men build a Ship (which c them 2700 *l.*) *viz.* *A, B,* and *C,* and they ſo agr that *B.* is to pay double what *A.* muſt pay, and tripple to that which *B.* payeth, I would know h much every Man ought to pay. To reſolve t

Queſti

ueſtion, I ſuppoſe *A.* paid 6 *l.* therefore *B.* paid
l. and *C.* muſt pay 36 *l.* But by this Poſition of
.+12 *l.*+36 *l.* added, maketh 54 *l.* which by
e intent of the Queſtion ought to have been 2700 *l.*
evertheleſs, by thoſe ſuppoſitial Numbers, I ſhall diſ-
ver the true Sums which the ſeveral Parties ought
pay ; for I ſay by the *Rule of Three Direct*:

```
      l.            l.                 l.
1.  As 54 is to —— 6 ——what will   2700
                                      6
                                  ———————
          l.                       16200
  54)16200(300 A. muſt pay        ———————
     162···
    ————————
      000
    ————————
      l.            l.                 l.
.   As 54 is to —— 12 ——what will  2700
                                     12
                                  ———————
          l.                       32400
  54(32400(600 B. muſt pay.       ———————
     324···
    ————————
      0
    ————————
      l.            l.                 l.
    As 54 is to —— 36 ——what will  2700
                                     36
          l.                      ———————
  54)97200(1800 C. muſt pay.       16200
     54····                        8100
    ————————                      ———————
     432                           97200
     432                          ———————
    ————————
     000
```

For PROOF.

		l.
A.	pays	300
B.	pays	600
C.	pays	1800
Total is		2700 the Sum propou

Queſt. 2. A Gentleman having about him a c tain Number of Crowns, ſaid if a Fourth, a Thi and a Sixth of them, were added to what he h about him they would make 45 Crowns, what w the Number of Crowns he had about him?

Anſwer 60 Crowns

I ſuppoſe he had 24 *Crowns then.*

	Crowns
$\frac{1}{4}$ of 24 is	6
$\frac{1}{3}$ of 24 is	8
$\frac{1}{6}$ of 24 is	4
All which make	18

But if 18 come of 24 what will 45 Crowns

```
        45
        24
       ———
       180
        90
       ————
   18)1080(60 Cro
       108
       ———
        00
```

PROOF.

	Crowns
$\frac{1}{4}$ of 60 is——	15
$\frac{1}{3}$ of 60 is——	20
$\frac{1}{6}$ of 60 is——	10
Facit	45 Crowns.

Queſt. 3. A Traveller found, ½ more, ⅓ more, more, would have made it 50 *l.* what did he ?

Anſwer, 46 *l.* $\frac{2}{13}$.

I ſuppoſe he found 12 *l.*

Then the

$$\begin{array}{lr} & l. \\ \frac{1}{2} \text{ of } 12 \text{ is} & 6 \\ \frac{1}{3} \text{ of } 12 \text{ is} & 4 \\ \frac{1}{4} \text{ of } 12 \text{ is} & 3 \\ \hline & 13 \end{array}$$

l. 13 —— come of —— *l.* 12 —— what will *l.* 50

$$\begin{array}{r} 50 \\ 12 \\ \hline 600 \\ \hline \end{array}$$

$$\begin{array}{l} \quad\quad l. \\ 13)600(46+\frac{2}{13} \\ \quad\ \ 52 \\ \quad\ \ \overline{\ 80} \\ \quad\ \ \ 78 \\ \quad\ \ \overline{\quad 2} \end{array}$$

PROOF.

$$\begin{array}{ll} & l. \\ \frac{1}{2} \text{ of } 46 \text{ is} & 23+0 \\ \frac{1}{3} \text{ of } 46 \text{ is} & 15+\frac{2}{3} \\ \frac{1}{4} \text{ of } 46 \text{ is} & 11+\frac{2}{4} \\ \text{add} & 1 \text{ ——} \\ & \text{—— } 1 \text{ Fraction.} \\ \text{Total} & 50 \end{array}$$

Queſt. 4. A Gentleman going over a Commo
asked a Shepherd how many Sheep he had? Anſwer
if I had as many more as I have, and $\frac{1}{2}$ ſo ma
more, $\frac{1}{3}$ more, $\frac{1}{4}$ more, and 1 more, I ſhould ha
112 Sheep, the Queſtion is how many had he?

Anſwer, 36 Sheep.

Suppoſe 24 *Sheep.*

24
Then the Number is 24
The $\frac{1}{2}$ is——12
The $\frac{1}{3}$ is—— 8
The $\frac{1}{4}$ is—— 6
1

75

If 75————24————112
24

448
224

2688

75)2688(35+$\frac{63}{75}$ *fere.*
225

438
375

63

36
36
18
12
9
1

112 Sheep.

ueſt. 5. One ſaid he knew not what Money he in his Purſe, but he knew that the third Part, he fourth Part, and the fifth Part thereof would e 94 Pounds, what Money had he ?

Suppoſe 60 *l.* Anſwer, 120 *l.*

l.
The $\frac{1}{3}$ Part is 20
$\frac{1}{4}$ Part is 15
$\frac{1}{5}$ Part is 12

47

l. *l.* *l.*
47 come of ——60———94
60

5640

l.
47)5640(120
47

94
94

00

P R O O F.

l.
For $\frac{1}{3}$ Part is 40
$\frac{1}{4}$ Part is 30
$\frac{1}{5}$ Part is 24

94

Queſt. 6. I have delivered to a Banker a ce
Sum of Money to have of him by the Year *6 l.*
every 100 *l.* and at the End of 10 Years he paid
500 Pounds for all, both Principal and Intereſt, w
was the Principal Sum I delivered him at firſt?

Suppoſe 100 *Pounds.*

```
              Months       l.                  Years
   Then if 12 ——————be  6 ———————————————— 10
                    l.                         12
        12)720(60 Simple-Intereſt.         ————
           72··                             120
          ——————                              6
            00                             ————
          ——————                            720
                                           ————
```

```
                   l.         l.              l.
        Then if 160——————be 100  what will   500
                                             100
                   l.    s.                 ————
        160)50000(312 : 10 is the Sum I     5000
            480···      delivered at firſt. ———
           ——————
             200
             160
            —————
             400
             320
            —————
 80/160 | 1/2.  80
            —————
```

Thus much for *Single Poſition.*

The next in Order is the *Double Rule of*
Double Poſition.

C H

CHAP. XXII.

Double Poſition.

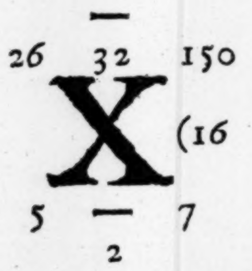
DEFINITION.

THE *Rule of Double Poſition* (or *Double Rule of Falſe,*) is when two falſe Poſitions are ſuppoſed, for the Reſolution of the Queſtion propounded.

The Operation.

In this Rule, having drawn two Lines a-croſs, and aced the Terms of the Falſe Poſition (*viz.* thoſe at have the ſame Denomination) at the uppermoſt nd of that Croſs, as alſo each Error under his reective Poſition, at the lower End of the ſame Croſs, ultiply each Error by its contrary Poſition; that the ſecond Error by the firſt Poſition, and the ſt Error by the ſecond Poſition. This done, hen both the Errors are of one and the ſame Kind, iz. both Exceſſes or both Defects) ſubtract the ſs Product out of the greater, and then the Reainder is your Dividend; but if the Errors be of iffering Kinds (*viz.* one of them an Exceſs, and the ther a Defect,) add thoſe Products together, and en that Sum will be your Dividend, which if you ivide by the Difference of their Errors, (when they are of one and the ſame Kind) or by their Sum (when they are of different Kinds) the Quotient will give you the Number you look for, having the ſame Denomination with the falſe Poſitions placed at the upper End of the Croſs; a few Examples will demonſtrate this Rule to be plain and eaſy.

Queſt. 1. A Workman having threſhed out 40 Quarters of Grain, (Part thereof being Wheat, and the reſt Barley, received for his Labour 28 *s.* being paid after the Rate of 12 *d.* for every Quarter of Wheat, and 6 *d.* for each Quarter of Barley: Now I would know how many of thoſe 40 Quarters were Wheat, and how many Barley.



Note, That this Character — ſignifies that the Leſſer of the two Numbers, betwixt which it is found, ought to be ſubtracted from the greater.

This done, having multiplied 26 by 7, the Product is 182, and likewiſe 30 by 5 the Product is 150; which being ſubtracted out of 182 (becauſe the Errors here are both of the ſame kind; that is, are each of them an Exceſs above 28 *s.* the Sum that the Workman received,) the Remainder is 32, which being divided by 2, (the Difference betwixt 5 and 7,) leaves in the Quotient 16 for the Quarters of Wheat that the Workman threſht, whoſe Complement to 40, *viz.* 24 are the Quarters of Barley that he threſhed. Thus I ſay, the Workman having received 28 *s.* for his threſhing out 40 Quarters of Grain, (being Part Wheat, Part Barley, at 12 *d.* the Quarter of Wheat

6 d. the Quarter of Barley; threſhed in all
uarters of Wheat, and 24 Quarters of Barley.
this firſt Operation as you may find by the
k itſelf, that there was at firſt propoſed at a
ure 26 Quarters of Wheat, and 14 of Barley;
hen to diſcover whether I have gueſſed Right
rong, I find how much Money is due unto the
kman, at the Rate of 12 *d.* the Quarter of
at, and 6 *d.* of Barley, which I find to be 33 *s.*
26 *s.* for the 26 Quarters of Wheat, and 7 *s.*
he 14 Quarters of Barley) which he ought to
received if my Suppoſition had been right; but
uſe of the Difference betwixt 28 *s.* and 33 *s.* I
in Mind 5, their Difference, which is called
irſt Error: Therefore I propound for the ſe-
Poſition, that there was 30 Quarters of Wheat,
o of Barley; and then the ſecond Error I find
7, for there is then due to the Workman for
o Quarters of Wheat 30 *s.* and for the 10 Quar-
of Barley 5 *s.* in all 35 *s.* which differs from
the true Sum that he received by 7 *s.* ſo that
nay perceive by the Operation, as in the Rule
ted, how all Queſtions, when the Poſitions are
Exceſſes may be performed.

herefore for the better underſtanding of the
before premiſed, I will ſet down the ſame Que-
under other Suppoſitions.

ueſt. 2. I ſuppoſe therefore for the ſecond Time
uarters of Wheat, and 30 Quarters of Barley,
hen proceeding as before, the firſt Error will
e 3 *s.* which upon that Poſition I want of 28 *s.*
ight Sum?

gain, for the ſecond Poſition I take 26 Quarters
Vheat, and 14 of Barley, and then the ſecond
r will be 5 *s.* too much of the true Sum of 28 *s,*
refore the firſt being a Defect of 3 *s.* and my laſt
Poſition

Poſition 5 *s.* too much; I therefore work by Rule, when the Poſitions are one of them an Exc and the other a Defect, as *per* the Operation may obſerve.

50 + 78
10 128 26
X (16
+
3 8 5

Note, That this Character + timates, that the Numb betwixt which it is fou ought to be added to ther.

EXPLANATION.

Now multiplying 10 by 5 the Product is 50, 26 by 3 the Product is 78; and here (becauſe Errors are of different Kinds, one of them being Exceſs, and the other a Defect of 28 *s.* the true S you then are to add 50 and 78, the two Prod together, whoſe Sum is 128, which being divi by 8, the Sum of the two Errors 3 and 5 gives in the Quotient 16, for the Quarters of Wheat before in the former Reſolutions; ſo that what P tions ſoever you take in this Queſtion, you ſhall ways find, that the Workman threſhed 16 Quar of Wheat, and 24 of Barley, as before propoun And becauſe you may not forget your Rule, this ſhort Remembrance.

Unlike require Addition,
And like deſire Subtraction.

Queſt. 3. A certain Man being demanded w was the Age of his four Sons? Anſwer'd, T his eldeſt Son was four Years elder than the ſec his ſecond Son was four Years elder than the th his third Son was four Years elder than the fourth

youn

ungeſt, and his fourth or youngeſt was half the ge of the eldeſt: The Queſtion is to know what as the Age of each Son?

Firſt, ſuppoſe the Age of the eldeſt 16, then by the ueſtion the Second muſt be 12, the third 8, and the urth or youngeſt 4: But it ought to have been ; ſo that it wants 4 of what it ought to be.

I therefore make a ſecond Suppoſition, and take o for the Age of the eldeſt Son, then the Age the ſecond will be 16, the Age of the third 12, d the Age of the fourth or youngeſt 8, which ould have been half 20, ſo that it wants 2 of what ought to have been; ſo that in both theſe Suppoſitions there are **Defects**, and by Conſequence a-like

The Scheme followeth:

—
6 48 20
X (24
4 — 2
2

Both **Defects**, work accordingly as *per* Rule.

16
2
———
32

20
4
———
80
32 add
———
48 Dividend.

4
2
———
2 Diviſor

2)48(24 Years of Age the eldeſt.

Therefore the Age of the Eldeſt is,

24 eldeſt Son.
20 ſecond Son.
16 third Son
12 youngeſt Son.

Which anſwers the Queſtion, for 12 the youngeſt Son is half the Age of the eldeſt, *viz.* 24.

Queſt. 4. Three Men, *A*, *B*, and *C*, built a Houſe which coſt 76 *l.* of which *A.* paid a certain Sum unknown, *B.* paid as much as *A.* and 10 over, and *C.* paid as much as *A.* and *B.* now I deſire to know each Man's Share in this Building?

6 $\overline{168}$ 9
X 14 for Anſwer.
32 $\overline{12}$ 20

Firſt, I ſuppoſe *A.* paid 6 *l.*
2dly, I ſuppoſe *A.* paid 9 *l.*

	l.	
A. pays	6	by the Queſtion.
B.——	16	
C.——	22	
In all	44	Pounds,

76
44
32

Which ſhould have been 76 *l.* therefore if I take 44 *l.* from 76 *l.* there is 32 Pounds too little.

Again,

$$\text{Again, I ſuppoſe}\begin{cases} A.\text{——} & 9 \\ B.\text{——} & 19 \\ C.\text{——} & 28 \end{cases}\ l.$$

56 Pounds.

But this 56 *l.* ſhould have been 76 *l.* refore too little by 20, ſo working according to the Rule you find 168 your Dividend, and 12 the Diviſor.

76
56
——
20

12)168(14 *l.* *A.* paid
12
——
48
48
——
0
——

Proof.

	l.
A. paid	14
B. paid	24
C. paid	38
In all	76

As by the Queſtion.

Queſt. 5. Let it be required to divide 100 *l.* ongſt 3 Perſons, *viz.* *A*, *B*, *C.* in ſuch a Manner t the Share of *B.* may be the triple of the Share *A*, and 4 Pounds over and above; alſo, that the re of *C.* may be equal to the Sum of the Shares *A.* and *B*, and ſix Pounds over and above.

THUS,

Let the firſt Poſition for the Share of be 12 Pounds, then *B.* muſt have 40 nds, and *C.* 58 Pounds: But 12 *l.* 40 *l.* 58 is 110 Pounds, which is 10 Pounds much.

l.
12
40
58
——
110

Then for a ſecond Poſition, I ſuppoſe for Share of A. 8 Pounds, then *B.* muſt h 28 Pounds, and *C.* 42 Pounds, but 8+ + 42=78 *l.* But this 78 Pounds is too little by 22 *l.* for if I ſubtract 78 from there will remain 22, which is too litt therefore this Queſtion by the Supp tions, proves one too little by 22, and other Suppoſition 10 Pounds too much.

8
28
42
———
78

264 + 80
12 34 8
X 10 *l.*+$\frac{3}{4}$ *A.* or 10 *l.* 15 *s.*
10 + 22
32

Proof.

	l.	*s.*
A.	10	15
B.	36	5
C.	53	0
	100	0 To

In all 100 *l.* according to the Queſtion.

Queſt. 6. A Gentleman riding over a Green, ask a Shepherd what was the Price of his hundred Shee Quoth he, Sir, I have not ſo many, but if I had many more, and half ſo many more, and 7. $\frac{1}{2}$ Shee I ſhould then have a Hundred, I demand how ma Sheep he had?

Anſwer 37 Sheep.

Th

Thus,

t, ſuppoſe	9	Secondly, ſuppoſe	11	
then	9	then	11	
o	$4\frac{1}{2}$		11	
o	$7\frac{1}{2}$		$5\frac{1}{2}$	100
			$7\frac{1}{2}$	35
o	30		35	65

en this firſt Suppoſition is too little by 70.

And this ſecond Suppoſition is too little by 65.

	585 — 770			70
65	9	185	11	11
9		X	(37	70
585				70
	70	—	65	770
		5		

Proof.

37
37
$18\frac{1}{2}$
$7\frac{1}{2}$

100 Sheep.

had then 37 Sheep; for if you divide 185 by 5, the Quotient will be 37.

Queſt. 7. Three Gameſters having gained 5 *l.* or o *s.* agree to divide it amongſt them thus, *viz.* *B*, and *C*. *B.* ſhall have more Shillings than *A.* 3, and *C.* ſhall have 4 Shillings more than *B*, how ny Shillings muſt each have ?

Thus,

Firſt I ſuppoſe *A.* ſhall have 33 *s.* then *B.* have 36, and *C.* 40, but the Sum of 33, 36, 40 makes 109, and ſhould have been but 100, th fore it is 9 too much.

Secondly, I ſuppoſe *A.* ſhall have 31 *s.* the muſt have 34, and *C.* 38 ; but 31, 34, and 38 103, which ſhould have been but 100, therefo am 3 too much, and the Errors are both Exceſſe

```
             279 +  99             33
 6)180(30    31  180  33             3
   18··                            ———
   ———           X      (30        99
   00
   ———           +                 31
              3  6   9              9
                                   ———
                                   279
                                   ———
```

So that *A.* had 30 *s.* *B.* 33 *s.*
and *C.* 37, which together
makes 100 Shillings.

Proof.
30
33
37
———
100 Sh

Queſt. 8. A Man gave away his Eſtate in Manner to *A.* $\frac{1}{2}$, and he gave back 10 *l.* to *B.* $\frac{1}{3}$, he gave back 6 *l.* and to *C.* $\frac{1}{4}$, and he gave back laſt of all he had 16 *l.* remaining, what was Eſtate?

Firſt Suppoſition, ſup-
ſe *60*, then

60. $\frac{1}{2}$ 30—10=20
60. $\frac{1}{3}$ 20—06=14
60. $\frac{1}{4}$ 15—04=11

45

45+16=*61* therefore
oo much.

Second Suppoſition; again, ſuppoſe 120 *l.* then

120. $\frac{1}{2}$ *60*—10=50
120. $\frac{1}{3}$ 40—06=34
120. $\frac{1}{4}$ 30—04=26

110

110+16=126 which is *6* too much.

```
240(48      360 —
20''        60    240  120
——
 40              X      48}
 40
——           1   —   6
 0                5
```

his Eſtate was 48 *l.*

For Proof.

48. $\frac{1}{2}$ 24—10=14 *A.*
48. $\frac{1}{3}$ 16—06=10 *B.*
48. $\frac{1}{4}$ 12—04=08 *C.*

32+16=48 *l.*

Queſt. 9. A certain Country Maid, having in her ſket a certain Number of Eggs, left (without aking any) half that Number, and half an Egg one Place, at a ſecond Place half the Remainder d half an Egg, at a third Place half the Remain-, and half an Egg, and at laſt had one Egg left, v many had ſhe at firſt?

Thus,

Firſt ſuppoſe *63*. $\frac{1}{2}$ $31+\frac{1}{2}$ $\frac{1}{2}$ is 32
31. $\frac{1}{2}$ $15+\frac{1}{2}$ $\frac{1}{2}$ = 16
15. $\frac{1}{2}$ $7+\frac{1}{2}$ $\frac{1}{2}$ = 8
add 1

57

63
57

6 too little.

Again ſuppoſe 23 — 138

63 75 23

Then 23. $\frac{1}{2}$ $11+\frac{1}{2}+\frac{1}{2}=12$ X (15

11. $\frac{1}{2}$ $5+\frac{1}{2}+\frac{1}{2}=6$

5. $\frac{1}{2}$ $2+\frac{1}{2}+\frac{1}{2}=3$

add 1 6 — 1

23
22 Too little 22

1

5)75(15
5
25

So that the Maid had 15 Eggs; for the $\frac{1}{2}$ of 15 is $7\frac{1}{2}$, to which adding $\frac{1}{2}$ the Sum is 8, left at the firſt Place, then ſhe had 7 left; then the $\frac{1}{2}$ of 7 is $3\frac{1}{2}$, to which add $\frac{1}{2}$ maketh 4, which ſhe left at the ſecond Place, then ſhe had 3 left; the $\frac{1}{2}$ of 3 is $1\frac{1}{2}+\frac{1}{2}=2$, which ſhe delivered at the third Place: In all ſhe left 14 Eggs, and had 1 left according to the Queſtion.

8
4
2
14

Queſt. 10. A Shepherd in the Time of War driving a Flock of Sheep, fell into the Hands of three Companies of plundering Soldiers, who forc'd him to deliver the $\frac{1}{2}$ of his Flock with a Sheep over and above to the firſt Company. Alſo $\frac{1}{2}$ of his remaining Flock with $\frac{1}{2}$ a Sheep to the ſecond Company: Likewiſe the $\frac{1}{2}$ of the reſt of his Flock with $\frac{1}{2}$ a Sheep to the third Company: All which Diviſions the Shepherd exactly performed without killing a Sheep, and then there remained only 20 Sheep for himſelf. The Queſtion is, to find how many Sheep the Shepherd had in his Flock at firſt?

Anſwer, 167.

For the firſt, ſuppoſe 287 Sheep.

hen 287. $\frac{1}{2}$ $143+\frac{1}{2}+\frac{1}{2}=144$ | 287
143. $\frac{1}{2}$ $71+\frac{1}{2}+\frac{1}{2}=72$ | 272
71. $\frac{1}{2}$ $35+\frac{1}{2}+\frac{1}{2}=36$ | ——
—— | 15 too little

252
add 20
——
272

Secondly, ſuppoſe 367 Sheep.

en 367. $\frac{1}{2}$ $183+\frac{1}{2}+\frac{1}{2}=184$
183. $\frac{1}{2}$ $91+\frac{1}{2}+\frac{1}{2}=92$
91. $\frac{1}{2}$ $45+\frac{1}{2}+\frac{1}{2}=46$
——
322
add 20
——
342

this ſecond Poſition I find 25 too little.

7175 —— 5505
287 1670 367
X (167 Sheep at firſt.
15 — 25
10

that it appears that the Shepherd had 167 in his Flock at firſt.

The

The PROOF.

1. Firſt Company, ½ of 167 is 83. ½, to w
add ½ the Sum, is 84, which was delivered to
firſt Company of plundering Soldiers, then there
mained to the Shepherd 83 Sheep.

2. Second Company, ½ of 83 is 41. ½+½ is
the Number of Sheep he deliver'd to the ſecond C
pany, and then there remained to the Shepherd 4

3. Third Company, ½ of 41 is 20. ½+½ is
the Number of Sheep he delivered to the t
Company; and ſo at length there remain'd 20 S
to the Shepherd, as the Queſtion required.

		Sheep
	For the firſt Company took	84
167	Second Company took	42
147	Third Company took	21
20 Sheep left.		147
		20 Sheep le
		167

Thus much for Arithmetick in whole Numb

CH

CHAP. XXIII.

be Doctrine of Vulgar Fractions.

meration, or the Definition of a Fraction.

A *FRACTION* or broken Number is a Part, or Parts of many whole Numbers. For as whole Numbers take their Beginning from 1, and ſo
ue in Number without End; ſo the ſaid
Number may be diſſolved into Parts or Pieces
e.

refore to attain unto the Knowledge of Fractions,
uſt acquaint yourſelf with theſe two Terms,
Numerator and *Denominator*.

rator	2	2	3	7	10	13	240	
	—	—	—	—	—	—	—	thus expreſs'd.
inator	5	3	4	9	12	20	459	

gnifieth two fifth Parts of any whole Number,
ity, and ſo of all the reſt.

Reduction.

Definition. TEacheth to bring Integers into ctions, or contrarywiſe Fra of divers Denominations into one, or what yo want, or deſire.

To reduce proper Fractions.

Note, When 3 or more Fractions, which ha equal Denominators are given to be reduced.

The RULE *is.*

Multiply the Numerator of each Fraction, all the Denominators, except its own, conti one into another; ſo are the ſeveral Products a from ſuch continual Multiplication a new N rator.

Laſtly, multiply all the Denominators tog continually, ſo is the Product a common Deno tor to all the new Numerators.

As for EXAMPLE.

Reduce $\frac{3}{4}$ $\frac{4}{5}$ into one common Denominator.

Thus,

$$\frac{3}{4} \quad \frac{4}{5}$$

$$\frac{15}{20} \quad \frac{16}{20}$$

For 3 times 5 i
and 4 times 4
new Numera
and 4 times 5 i

So that $\frac{15}{20}$ $\frac{16}{20}$ are common Denominators, and equal to $\frac{3}{4}$ and $\frac{4}{5}$.

Example 2. Reduce $\frac{4}{5}$ $\frac{6}{7}$ $\frac{5}{9}$ into one Denomination.

Thus,

252	270	175
$\frac{4}{5}$	$\frac{6}{7}$	$\frac{5}{9}$

Common Denom. 315——

So that $\frac{252}{315}$ $\frac{270}{315}$ $\frac{175}{315}$ are equal to $\frac{4}{5}$ $\frac{6}{7}$ $\frac{5}{9}$ as ſhall be hereafter demonſtrated by Abbreviation of which in its due Place.

Example 3. Likewiſe Reduce $\frac{2}{4}$, $\frac{3}{5}$, $\frac{10}{12}$, $\frac{4}{9}$, $\frac{17}{14}$ into one Denomination.

Being reduced per *your Rule are*

Nume.	15120	18144	25200	13440	36720
Denom.	30240	30240	30240	30240	30240

Reduction of Fractions of Fractions.

A Fraction of a Fraction is that, which hath more Numerators and Denominators than one, and is to be diſcovered by the Word [*Of*] which is interpos'd between the Parts of ſuch Compound Fraction, as $\frac{2}{3}$ of $\frac{3}{4}$ is a Fraction of a Fraction of an Integer of a Pound *Sterling*, or any Thing elſe, either of Weights, Meaſures, or any other Kinds.

The RULE.

Multiply all the Numerators together, and take the Product thereof for a Numerator, and likewiſe multiply all the Denominators together, and make the Total a new Denominator.

As for EXAMPLE.

Reduce $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ into a ſingle Fraction; being reduced it makes $\frac{6}{24}$ and is a ſingle Fraction.

$$\begin{array}{c} 6 \\ \hline \frac{1}{2} \text{ of } \frac{2}{3} \text{ of } \frac{3}{4} \\ \hline 24 \end{array}$$

Again, reduce $\frac{6}{8}$ of $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{5}{7}$ of $\frac{2}{6}$ into a ſingle Fraction.

Numer:	720	720	720	720
Common Denom.	6720			

$\frac{720}{6720}$.

To reduce improper Fractions into whole Numbers.

An improper Fraction is that, whoſe Numerator is either greater, or at leaſt equal unto the Denominator; ſo this Fraction $\frac{8}{4}$ that is eight fourths, is called an improper Fraction, and ſo is this $\frac{4}{4}$, for indeed a Fraction of this Kind, may well be ſirnamed improper, ſince it is always greater than an entire Unity, or t leaſt equal unto it. An Improper Fraction may reduced into its equivalent whole Number or t Number in this Manner.

The R U L E.

ivide the Numerator by the Denominator, ſo is Quotient the whole Number or mixt Number ght.

As for E X A M P L E.

educe $\frac{26}{5}$ into its equivalent mixt mber, the Number will be 5 *l.* $\frac{1}{5}$ 5 *l.* 4 *s.* for if 26 be divided by 5, Quotient is 5. $\frac{1}{5}$.

5)26(5. $\frac{1}{5}$
25
———
1

educe $\frac{10}{4}$. *Facit* 2 *l.* $\frac{2}{4}$

4)10(2. $\frac{2}{4}$.
8
———
2

educe $\frac{406}{12}$. *Facit* 33. $\frac{10}{12}$.

12)406(33. $\frac{10}{12}$
36
———
46
36
———
10

lſo the improper Fraction $\frac{52}{4}$ will be reduced in- the whole Number 13.

4)52(13
4
———
12
12
———
0

To

To reduce a mixt Number into an improper Fraction.

A mixt Number is that, which beſides the int gral Parts, or entire Unities of which it conſiſ hath alſo a Fraction annexed unto it thus : 2. $\frac{1}{2}$, *Fa* 7. $\frac{3}{4}$ of a Mile.

A mixt Number may be reduced into an impro per Fraction by this

RULE.

Multiply the integral Part (or whole Numbe by the Denominator of the Fraction, and to the Pr duct add the Numerator, and that Sum place ov the Denominator; ſo this new Fraction ſhall be equ to the mixt Number given.

As for EXAMPLE.

Reduce 2 *l.* $\frac{5}{9}$. *Facit* $\frac{23}{9}$. For 9 times 2 is 1 and 5 is 23, which is equal unto $\frac{23}{9}$.

Again, reduce this mixt Number 5 *l.* $\frac{1}{5}$. into improper Fraction. *Facit* as by the Rule $\frac{26}{5}$.

To reduce a whole Number into an improper Fraction.

Multiply the given Number by the intended D nominator, and Place the Product for a Numerat over it.

As for EXAMPLE.

Reduce 15 into a Fraction, whoſe Denominator ſhall be 12. *Facit* $\frac{180}{12}$ for 15 multiplied by 12 *facit* $\frac{180}{12}$.

$$\begin{array}{r}15\\12\\\hline 180\end{array}$$

Reduce 36 into a Fraction whoſe Denominator ſhall be 20.

$$\begin{array}{r}36\\20\\\hline 720\end{array}$$

Facit $\frac{720}{20}$.

Reduce 24 into an improper Fraction, by ſetting 1 under it for a Denominator, it is a Fraction improper.

Thus $\frac{24}{1}$.

Reduction or Abbreviation, or Some Rules whereby the Manner *to abbreviate.*

1. Two Numbers being given, their greateſt common Meaſure, (that is the greateſt Number, which will meaſure or divide both Numerator, and Denominator without leaving any Remainder) may be found in this Manner, *viz.*

Divide the greater Number by the leſſer, then divide the laſt Diviſor by the Remainder, and ſo continue dividing the laſt Diviſors by the Remainders, until there be no Remainder, (neglecting the Quotients;) ſo is the laſt Diviſor the greateſt common Meaſure unto the Numbers given.

As for EXAMPLE.

Abbreviate $\frac{3077}{4163}$ thus:

3077)4163(1 | 1086)3077(2 | 905)1086(1 | 181)905(5
3077 2172 905 905
——— ——— ——— ———
1086 905 181 0

So that 181 is the common Meaſure.

181)3077(17 181)4163(23
181·· 362··
——— ———
1267 543
1267 543
——— ———
0 0

Facit $\frac{17}{23}$ is equal to $\frac{3077}{4163}$.

Examp. 2. Again abbreviate $\frac{91}{117}$ thus; as by the Rule.

91)117(1 26)91(3 13)26(2 So that 13 is the common Meaſure.
91 78 26
——— ——— ———
26 13 0

13)91(7 13)117(9 *Facit p.* common Meaſure $\frac{7}{9}$ equal to $\frac{91}{117}$.
91 117
——— ———
0 0

But here you are to obſerve nicely, that if the greateſt common Meaſure unto the Numerator and Denominator be 1, ſuch Fraction is in its loweſt Terms already, ſo the Fraction $\frac{15}{171}$ cannot be reduced into lower Terms, becauſe the greateſt common Meaſure will be found 1. The like may happen of many other Numbers. And although the laſt be a general Rule for the abbreviating, or bringing of Fractions into their loweſt Terms, yet Experience daily ſhews to us other practical Rules, which in ſome Caſes will be more eaſily and readily found out, as is well known unto thoſe, whoſe Practice is continually uſed, *viz.* When you ſhall obſerve the Numerator and Denominator to be even Numbers, you may meaſure them by 2, as $\frac{16}{64}$.

$\frac{16}{64}\Big|\frac{8}{32}\Big|\frac{4}{16}\Big|\frac{2}{8}\Big|\frac{1}{4}$ ſo that $\frac{16}{64}$ comes to $\frac{1}{4}$.

Again, when the Numerator and Denominator, ſhall each of them End with 5 or 0, they may be both meaſured by 5, ſo

$5)\frac{225}{475}\Big|\frac{45}{95}\Big|\frac{9}{19}$ $\frac{50}{425}\Big|\frac{10}{85}\Big|\frac{2}{17}$.

Whenſoever you can eſpy any other Number, which will exactly Meaſure both Numerator and Denominator, you may then divide them.

Thus $4)\frac{28}{84}\Big|\frac{7}{21}\Big|\frac{1}{3}$ thus $\frac{28}{84}=\frac{1}{3}$.

Likewiſe if the Numerator and Denominator, do each of them end with a Cypher or Cyphers, cut off equal Cyphers in both, ſo will the Fraction be reduced into its loweſt Value.

So $\frac{4|00}{5|00}$ is reduce to $\frac{4}{5}$, or $\frac{7|00}{90|00}$ is $\frac{2|0}{5|0}=\frac{2}{5}$.

$\frac{12|0000}{15|0000}\Big|=\frac{2}{3}$ $\frac{2|00}{4|00}\Big|\frac{1}{2}$

To find the Value of a ſingle Fraction in the known Parts of an Integer.

The Value of a ſingle Fraction in the known Parts of an Integer, may be found in this Manner, *viz.* multiply the Numerator of the Fraction propounded, by the Number of known Parts of the next inferior Denomination, which are equal to the Integer, and divide that Product by the Denominator; ſo is the Quotient the Value of the Fraction in that inferior Denomination; and if there happen to be any Fraction in the Quotient, you may find the Value thereof in the next inferior Denomination, by the ſame Rule, and ſo proceed till you come to the leaſt known Parts: A few Examples in the Operation, will make it more plain and eaſy than Words can ſo aptly expreſs.

As for EXAMPLE.

$$\begin{array}{r l}
20 & \\
9 & \\
\hline & s. \\
16)180(11. & \frac{16}{4}. \\
16 & \\
\hline 20 & \\
16 & \\
\hline 4 & \\
12 & d. \\
\hline & d. \\
16)48(3 & \\
48 & \\
\hline 0 &
\end{array}$$

What is the Value of $\frac{9}{10}$ of a Pound Sterling thus found; multiply the Numerator 9 by 20 (which are equal to a Pound *Sterling,*) the Product is 180, which being divided by 16, the Quotient is 11. $\frac{4}{16}$ Shill. In like Manner multiply the Numerator 4 by 12 the Number of Pence in a Shilling, the Product is 48, which being divided by the common Denominator 16, the Quotient is 3 Pence.

But for the better Information of the Learner, I will take a Sum of *Diviſion* and you may better know ow what the Remainder amounts to, divide 01531 by 19.

```
19)3201531(168501. 12/19 Quotient.
   19
   ---
    130
    114
    ---
     161
     152
     ---
       95
       95
      ---
      031
       19
      ---
       12
       20
      --- s.
   19)240(12
      19
      ---
       50
       38
      ---
       12
       12
      --- d.
   19)144(7
      133
      ---
       11
        4
      ---
    19)44(2 farth. 6/19.
       38
      ---
        6
```

Now to know what the Fraction is, the integral Part being Pounds, by the Rule, reduce the 12 into Shillings by 20, *facit* 12 *s.* and 12 a Fraction remaineth, which I multiply by 12, and the Product divide by 19 and it maketh 7 *d.* and 11 remains, which I bring into Farthings; by multiplying by 4, and dividing the Product by 19, maketh 2 in the Quotient, which is 2 Farthings, and 6 for a Fraction or $\frac{6}{19}$.

Thus it plainly appears, That if 3201531 Pound were to be diſtributed among 19 Men, ea Man muſt have 168501 Pounds, 12 Shillings, 7 Penc 2 Farth. and $\frac{6}{19}$; ſo that 'tis more than 2 Farthing but farther our Money runs not.

Some Examples with their Anſwers

What is the Value of $\frac{27}{29}$ of a Pound *Sterl.*

Anſwer, 18 *s.* 7 *d.* 1 *far.* $\frac{23}{29}$

Thus found.

```
      27
      20
    ———— s.
 29)540(18
    29··
    ————
     250
     232
    ————
      18
      12
    ———— d.
 29)216(7
    203·
    ————
      13
       4
    ————far.
 29)52(1. 23/29. almoſt a Farthin
    29·
    ————
    23
```

What is the Value of $\frac{11}{15}$ of a Pound *Sterling.*

Anſwer, 14 *s.* 8 *d.*

What is the Value of $\frac{28}{137}$ of a Pound *Sterling.*

Anſwer 4 *s.* 1 *d.* $\frac{7}{137}$.

What is $\frac{16}{21}$ of a hundred Weight ?

Anſwer, 3 *qrs* 1 ℔. 5 *oz.* 2 *drams*, 1 *ſcruple.*

What is $\frac{136}{371}$ ℔. *Troy.*

Anſwer, 4 *oz.* 7 *pwt.* 23 *gr.* $\frac{179}{371}$.

What is $\frac{31}{50}$ of a Year?

Anſwer, 229 *Days*, 7 *Hours*, 12 *Minutes.*

What is the Value of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{9}{10}$ of a Pound *erling*, being reduced are $\frac{135}{240}$.

Anſwer, 11 *s.* 3 *d.*

Then,

```
      135
       20
    ------
 240)2700(11 s.
     240
    ------
      300
      240
    ------
       60
       12
    ------
 240)720(3 d.
     720
    ------
       0
```

Thus much for *Reduction of Fractions*, which the arner ought well to underſtand; proceed we now *Addition.*

Addition of Vulgar Fractions.

If your Fractions to be added have a common De nominator, then add all the Numerators tog ther, and place their Sum for a Numerator, to th common Denominator, which new Fraction is th Sum of all the given Fractions; and if they ar mixt or improper, reduce them to a whole or mi Number.

As for EXAMPLE.

Example 1. Add $\frac{2}{5}$ and $\frac{3}{5}$ of any Thing tog ther.

Facit $\frac{5}{5}$ or Unity.

Examp. 2. Add $\frac{7}{8}$ $\frac{5}{8}$ and $\frac{3}{8}$ with $\frac{2}{8}$.

Facit $\frac{17}{8}$ or $2.\frac{1}{8}$.

For 7 | 8)17(2. $\frac{1}{8}$.
5 | 16
3 | ——
2 | 1
—— | ——
17 |

Examp. 3. Add $\frac{2}{3}$ and $\frac{3}{5}$ together?

Facit $1.\frac{4}{15}$.

$$\begin{array}{ccc} 2 & & 3 \\ & \mathrm{X} & \\ 3 & & 5 \end{array}$$

$$\begin{array}{r} 10 \\ 9 \\ \hline 19 \text{ or } 1.\ \frac{4}{15}. \\ \hline 5 \end{array}$$

Examp. 4. What is the Sum of $\frac{3}{5}$ $\frac{7}{8}$ $\frac{9}{10}$ and $\frac{11}{12}$.

The Fractions reduced to a common Denominator are,

Num. $\frac{2880}{4800}$ $\frac{4200}{4800}$ $\frac{4320}{4800}$ $\frac{4400}{4800}$

The Sum of the Numerators are,

$\frac{158|00}{48|00}$ or $\frac{158}{48} = 3.\ \frac{7}{24}$.

The Sum required is a mixt Number, *viz.* 3 $\frac{7}{24}$.

Of Compound Fractions.

Examp. 5. Add $\frac{3}{5}$ and $\frac{2}{3}$ of $\frac{1}{4}$ together.

$$\begin{array}{ccc} \frac{3}{5} & & \frac{1}{6} \\ & \mathrm{X} & \end{array}$$

$\frac{2}{3}$ of $\frac{1}{4}$ is $\frac{2}{12}|\frac{1}{6}$

$$\begin{array}{r} 18 \\ 5 \\ \hline 23 \text{ add.} \\ \hline 30 \end{array}$$

Facit $\frac{23}{30}$.

Examp. 6. What is the Sum of $\frac{3}{5}$ $\frac{4}{6}$ and $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$.

Reduce $\frac{7}{8}$ of $\frac{3}{4}$ of $\frac{5}{6}$ into a ſimple Fraction, and it maketh $\frac{105}{192}$, which reduced with the other two Fractions, *viz.* $\frac{3}{5}$ $\frac{4}{6}$, are

New Num.	3456	3840	3150
Denom.	5760	5760	5760

Add the Num.

$$\begin{array}{r} 3456 \\ 3840 \\ 3150 \\ \hline 5760)10446(1.\ \frac{4686}{5760} \\ 5760 \\ \hline 4686 \end{array}$$

Facit 1 *l.* $\frac{4686}{5760}$.

Of Fraction of Fractions.

Examp. 7. Add $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ unto $\frac{4}{5}$ of $\frac{6}{7}$ unto a ſimple Fraction.

$$\frac{6}{\frac{1}{2}\text{ of }\frac{2}{3}\text{ of }\frac{3}{4}}\,24 \qquad \frac{24}{\frac{4}{5}\text{ of }\frac{6}{7}}\,35$$

add

$$\frac{6}{24} \times \frac{24}{35}$$

Facit $\frac{786}{840}$.

$$\begin{array}{r} 576 \\ 210 \\ \hline 786 \\ \hline 840 \end{array} \qquad \begin{array}{r} 35 \\ 24 \\ \hline 140 \\ 70 \\ \hline 840 \end{array}$$

840 Denom.

Remember to multiply croſs-wiſe thus, 24 multiplied by 24 is 576, and 6 by 35 is 210, which being added, makes 786 a new Numerator to the Denom. 840.

Note, I would have you here take Notice, that ᵉ Fractions in all their Operations, are ever ppoſed to be ſimple Fractions of Integers, which ve one and the ſame particular Denomination; at is to ſay) if one of the Fractions given to be led, is a Fraction of a Pound *Sterling*, all the are to be eſteemed Parts of a Pound *Sterling*, and like is to be underſtood of all other Denomiions.

ote alſo, When Fractions of Integers of different ominations, are given to be added; they muſt of all be reduced into Fractions of Integers, ch ſhall have one and the ſame particular Denoation, and then you may add them together.

As for EXAMPLE.

$\frac{7}{9}$ of a Pound *Sterling*, $\frac{3}{5}$ of a Shilling, and $\frac{5}{8}$ of nny were given to be added, reduce the two latnto Fractions of a Pound *Sterling*, *viz.* $\frac{3}{5}$ of a ing is $\frac{3}{5}$ of $\frac{1}{20}$ of a Pound *Sterling*, which Frabeing reduced makes $\frac{3}{100}$: Likewiſe $\frac{5}{8}$ of a y is $\frac{5}{8}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a Pound *Sterling*, which reduced is $\frac{1}{384}$. Laſtly $\frac{7}{9}$ $\frac{3}{100}$ and $\frac{1}{384}$, being ed and added will be found to make $\frac{280068}{345600}$ or of a Pound *Sterling*.

hen mixt Numbers are given to be added, find e Sum of all the Fractions, then add the Inter Integers, (if there be any found) in the Sum Fractions, unto the whole Numbers, and colem as before taught.

if $3.\frac{1}{2}$, $4\frac{1}{3}$, and $16.\frac{5}{8}$ were given to be added, Sum will be found to be $24.\frac{11}{24}$.

Thus found by the Operation.

The ſingle Fractions $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{5}{8}$ will be, $\frac{24}{48}$ $\frac{16}{48}$ which Numerators being added make 1. $\frac{11}{24}$, and th Sum of the whole Numbers collected together, t wit, 3, 4, and 16, makes 23, therefore the Total 24 $\frac{11}{24}$. For Anſwer 24 *l.* $\frac{11}{24}$ of a Pound, is t Sum of the mixt Numbers given to be added.

Subtraction of Vulgar Fractions.

The RULE.

WHEN the Numbers given are both ſin Fractions, and have one and the ſame D nominator, ſubtract the leſſer Numerator from t greater, and place the Remainder over the comm Denominator, ſo is ſuch new Fraction the Differe between the Fractions given.

As for EXAMPLE.

Examp. 1. Subtract $\frac{3}{8}$ from $\frac{7}{8}$, the Differenc $\frac{4}{8}$ or $\frac{1}{2}$.

Examp. 2. Subtract $\frac{7}{11}$ from $\frac{9}{11}$, there Rem $\frac{2}{11}$.

But when they have unequal Denominators, duce them into Fractions of the ſame Value, w ſhall have a common Denominator, and then their Difference as by the laſt Rule.

Exam

Examp. 3. Subſtract $\frac{6}{7}$ from $\frac{7}{8}$ reſt $\frac{1}{56}$, for $\frac{6}{7}$ and being reduced will be $\frac{48}{56}$ and $\frac{49}{56}$, ſo the Difference ou ſee to be $\frac{1}{56}$.

Examp. 4. What is the Difference between $\frac{5}{6}$ and of $\frac{5}{8}$. *Facit* $\frac{110}{240}$ or $\frac{11}{24}$.

For $\frac{3}{5}$ of $\frac{5}{8}$ being reduced to a ſimple Fraction, iz. $\frac{15}{40}$, then proceed as before taught, and you will nd it.

Anſwer, $\frac{110}{240}$ or $\frac{11}{24}$.

Of Mixt Numbers.

When one of the Numbers given is a whole umber, or a mixt Number, or if either of them e mixt Numbers, reduce ſuch whole or mixt umbers into an improper Fraction or Fractions, d then Work as before taught.

Subtract 7. $\frac{3}{5}$ from 12, the Remainder is found 4. $\frac{2}{5}$ r theſe two Fractions will be found to be $\frac{28}{5}$ and , whoſe Difference is $\frac{22}{5}$ or 4. $\frac{2}{5}$.

In like Manner 3 *l.* $\frac{2}{3}$ being to be ſubtracted from *l.* $\frac{3}{4}$, the Remainder will be found $\frac{25}{12}$ or 2 *l.* $\frac{1}{12}$, as the ſubſequent Operation.

l. *l.*
5. $\frac{3}{4}$ 3. $\frac{2}{3}$
$\frac{23}{4}$ $\frac{11}{3}$
69 12 Deno.
44
25 Num.

So there is $\frac{25}{12}$ or 2 *l.* $\frac{1}{12}$ as before.

For 4 multiplied by 3 is 12 for Numerator.

From 12 take 7. $\frac{3}{5}$ thus,

$\frac{12}{1}$ $\frac{38}{5}$

12
5

60
38 Subtr.

Reſt $\frac{22}{5}$ 22

For Anſwer, remains $\frac{22}{5}$ or 4. $\frac{2}{5}$.

To ſubtract a whole Number from a mixt Number.

When a whole Number is given to be ſubtracted from a mixt Number, ſubtract the ſaid whole Number, from the whole Part of the mixt Number; and unto the Remainder annex the fractional Part of the mixt Number given, ſo is the mixt Number ſo found the Difference ſought.

As for EXAMPLE.

Received $\frac{24}{7}$ of a Pound, laid out 7 *l.* what remains.

24
7 Subtr.

17. $\frac{5}{8}$ Remains, as by the Rule.

Received 15. $\frac{3}{4}$ of a Pound, laid out *9 l.*

15
9

6. $\frac{3}{4}$ Remains

l.
For if you receive 15 :
And lay out *9*
There will reſt *6* :

To ſubtract a Fraction from an Integer.

When a Fraction is given to be ſubtracted from an teger, ſubtract the Numerator from the Denominator, and place that which remains over the Denoinator, which new Fraction is the Difference ught.

So $\frac{3}{5}$ being ſubtracted from an Integer or 1. the emainder is $\frac{2}{5}$.

Alſo $\frac{13}{19}$ being ſubtracted from 1, the Remainder $\frac{6}{19}$.

Fraction from a whole Number greater than 1.

When a Fraction is given to be ſubtracted from a hole Number greater than 1, ſubtract the ſaid Fraion from one of the Integers given by the laſt ule; ſo the remaining Fractions being annexed to e Number of Integers leſſened by 1, will give the emainder.

Thus $\frac{4}{9}$ being ſubtracted from 6, the Remainder 5. $\frac{5}{9}$.

Alſo $\frac{7}{12}$ from 39 reſt 38. $\frac{5}{12}$.

Or $\frac{6}{9}$ from 2. reſts 1. $\frac{3}{9}$.

---

o ſubtract a whole Number and a Fraction from a whole Number and a Fraction.

Firſt reduce your Fractions into one Denominaon, then ſubtract the one Numerator from the other; and for the Integers ſubtract as in whole Numbers.

As for E X A M P L E.

Received 30 *l.* $\frac{3}{4}$, laid out 10 *l.* $\frac{1}{2}$. Firſt reduce $\frac{3}{4}$ and $\frac{1}{2}$ into one Denomination.

$30 . \frac{3}{4}$
$10 . \frac{1}{2}$ $\quad \frac{3}{4} \; \frac{1}{2}$

Reſt $20 . \frac{1}{4}$ $\quad \frac{2}{8}$ or $\frac{1}{4}$

l.
Again, Received $100 . \frac{5}{6}$
Paid $93 . \frac{3}{5}$

Remains $7 . \frac{7}{30}$

Thus,

7
$25 . \quad 18$
$\frac{5}{6} \quad \frac{3}{5} = \frac{7}{30}.$
30

Reduce the Fractions as you find by the Operation.

Of Fractions of Fractions.

When Fractions of Fractions are to be ſubtracted, they muſt be reduced into ſingle Fractions, then ſubtract as before taught.

Subtract $\frac{1}{}$ of $\frac{2}{3}$ from $\frac{3}{4}$ of $\frac{4}{5}$.

Being reduced they are $\frac{1}{3}$ and $\frac{3}{5}$.

$$\begin{array}{cc} \multicolumn{2}{c}{4} \\ \hline 5 & 9 \\ \hline \frac{1}{3} & \frac{3}{5} \\ \hline \multicolumn{2}{c}{15} \end{array} \qquad \text{Reſt } \frac{4}{15}.$$

To diſcern the greater of two Fractions.

N. B. Thoſe Fractions are always accounted the greateſt, whoſe Numerator multiplied by the Denominator of the other Fraction, maketh the greateſt Number.

Thus $\frac{7}{8}$ is greater than $\frac{3}{5}$; for 7 times 5 is greater than 8 times 3.

* * *

Multiplication of Vulgar Fractions.

The RULE.

IN *Multiplication* of *Vulgar Fractions*, you muſt Note, that when the Numbers given to be multiplied are both ſingle Fractions, multiply the Numerators one by the other, ſo is the Product a new Numerator; alſo multiply the Denominators one by the other, ſo is the Product a new Denominator, which new Fraction is the Product ſought.

As for EXAMPLE.

Multiply $\frac{2}{3}$ by $\frac{3}{4}$. *Facit* $\frac{6}{12}$ or $\frac{1}{2}$.

So $\frac{7}{12}$ and $\frac{5}{8}$ being given to be multiplied, the Product will be $\frac{35}{96}$.

Alſo $\frac{5}{7}$ multiplied by $\frac{3}{7}$ *facit* $\frac{15}{49}$.

In this Rule of *Multiplication of Vulgar Fractions*, it might ſeem ſomewhat ſtrange; to many, that $\frac{1}{2}$ of a Pound multiplied by $\frac{1}{2}$ of a Pound, ſhould make but $\frac{1}{4}$ of a Pound; therefore I thought good in this Place to inform them (who ſhall ſee this Book) that as whole Numbers multiplied by whole Numbers do increaſe the Product; ſo proper Fractions multiplied by proper Fractions, do diminiſh the Product. For as 1 multiplied by 1 makes but 1, ſo that which is leſs than 1 being multiplied, muſt needs make leſs than 1, for $\frac{3}{4}$ of a Pound being multiplied by $\frac{2}{3}$ of a Pound makes but $\frac{1}{}$ a Pound. $\frac{3}{4}$ by $\frac{2}{3} = \frac{6}{12}$ or $\frac{1}{2}$.

$\frac{1}{2}$ by $\frac{1}{2}$
$\frac{1}{4}$.

To multiply mixt Numbers.

Reduce ſuch whole Number, or mixt Number or Numbers, into an improper Fraction or Fractions, and then the Operation will be the ſame as in the laſt Rule.

So 8. $\frac{2}{3}$ being given to be multiplied by 5, the Product will be found 43. $\frac{1}{3}$, *viz.* 8. $\frac{2}{3}$ is $\frac{26}{3}$ alſo 5 is $\frac{5}{1}$, then multiplying 26 by 5, the Product is 130 for a new Numerator, alſo multiplying 3 by 1, the Product is 3 for a new Denominator, hence $\frac{130}{3}$ or 43. $\frac{1}{3}$.

In like Manner 7. $\frac{1}{2}$ being multiplied by 5. $\frac{3}{5}$, the
roduct will be found 42.

$$\begin{array}{ccc} 7.\frac{1}{2} & \text{by} & 5.\frac{3}{5} \\ 2 & & 5 \\ \hline 15 & & 28 \\ \hline 2 & & 5 \end{array} \qquad \begin{array}{rcl} \frac{15}{2} & \text{by} & \frac{28}{5} \\ & & 2 \\ \text{For } 28 & \text{by} & 5 \\ 15 & & \overline{10} \\ \hline 1|0)42|0(42 & & \end{array}$$

Note, There may be other Rules preſcribed, for
e multiplication of mixt Numbers; but becauſe
e Operation by ſuch Rules, would be little or no-
ing breifer than the Operations of the laſt Rule,
ſhall therefore make uſe of no other Rule than this,
hich is now made uſe of by Meaſurers, in their
eaſuring of Joyners, Carpenters, and Bricklayers
orks, commonly called *Croſs Multiplication.*

Thus if it be required to multiply 120 Feet $\frac{1}{4}$ by
Feet $\frac{1}{2}$, firſt multiply the whole Numbers conti-
ally; thus 120 by 48, and place the Products or-
rly one under the other.

Thus the whole Numbers make 5760,
en multiply alternately or Croſs-wiſe,
z. take $\frac{1}{4}$ of 48, which is 12, alſo take
f 120, which is 60, orderly to be ad-
d to the former. Laſtly, add all to-
ther, and to the Sum annex the Pro-
ct of the two Fractions, to wit in this
xample, the Product of the Multipli-
tion of $\frac{1}{4}$ by $\frac{1}{2}$, which is $\frac{1}{8}$, ſo the total
oduct required, will be 5832. $\frac{1}{8}$ as you
by the Operation in the Margent.

$$\begin{array}{rl} 120. & \frac{1}{4} \\ 48. & \frac{1}{2} \\ \hline 960 & \\ 480 & \\ \hline 5760 & \\ 12 & \\ 60 & \\ & \frac{1}{8} \\ \hline 5832. & \frac{1}{8} \\ \hline \end{array}$$

In like Manner, if 18. $\frac{1}{2}$ be multiplied by 40. $\frac{1}{3}$ the Product will be 746. $\frac{1}{6}$.

And if 29. $\frac{1}{2}$ Feet be multiplied by 50 Feet, the Product will be 1475, as by the Operation is manifeſt.

18. $\frac{1}{2}$	29. $\frac{1}{2}$
40. $\frac{1}{3}$	50
720	1450
20	25
6. $\frac{1}{6}$	1475 Feet.
746	

So if you multiply 4. $\frac{1}{2}$ by 4. $\frac{1}{2}$ or 4 *s.* 6 *d.* by 4 *s.* 6

	s. *d.* *s.* *d.*
4. $\frac{1}{2}$	4 : 6 by 4 : 6
4 $\frac{1}{2}$	4 : 6
16	16
2	2
2. $\frac{1}{4}$	2. $\frac{1}{4}$
20. $\frac{1}{4}$	20 *s.* 3 *d.*

For by multiplying croſs-wiſe, ſaying, 6 times is 24 *d.* which is 2 *s.* and ſo alternately again it 2 *s.* and the Fraction being the $\frac{1}{4}$ of a Shilling is 3 ſo that 4 *s.* 6 *d.* multiplied by 4 *s.* 6 *d.* is 20 *s.* 3 *d.*

In like Manner multiply 13 *s.* 4 *d.* by 13 *s.* 4 *d.*
nd it makes 8 *l.* 17 *s.* $\frac{12}{27}$ of a Penny.

Thus,

13. $\frac{1}{3}$
13. $\frac{1}{3}$
———
39
13
———
169
4. $\frac{1}{3}$
4. $\frac{1}{3}$
———
177. $\frac{1}{3}$
$\frac{1}{9}$
———
17|7
———
8|17. $\frac{12}{27}$ is Equal to 8 *d.* $\frac{12}{27}$.

Fractions of $\frac{1}{3}$ and $\frac{1}{9}$ = $\frac{12}{27}$
———
9
3
———

In like Manner multiply 3 Feet, 6 Inches by
Feet, 6 Inches.

Feet
3 : $\frac{1}{2}$
3 : $\frac{1}{2}$
———
9
1 : $\frac{1}{2}$
1 : $\frac{1}{2}$
$\frac{1}{4}$
———
12 : 0 : $\frac{1}{4}$
———

Facit 12 Feet $\frac{1}{4}$ of an Inch.

To put into it Money, Multiply 3 *s.* 6 *d.* by 3 *s.* 6

s. *d.*
3 : 6
3 : 6

9
1 : 6
1 : 6 : 3

12 : 0 : 3 Anſw. 12 *s.* 3 *far.*

Multiply 5 *l.* 5 *s.* 5 *d.* by 5 *l.* 5 *s.* 5 *d.*

Anſwer, 27 *l.* 15 *s.* 7 *d.* $\frac{7}{12}$.

Operation by Fractions by the laſt Rule.

l. *s.* *d.*
5 : 5 : 5 5 *d.* is $\frac{5}{12}$ of $\frac{1}{20}$ *viz.* +
20 $\frac{105}{20}$ $\frac{5}{240}$

105
105
20 240 20
20 5

4200
400 210 100
12

New 25200
Den. 4800 100

New Num. 253|00

48|00

48	$\frac{253}{48}$ by $\frac{253}{48}$	253
48		253
384		759
192		1265
2304		506
		64009

Anſwer, $\frac{64009}{2304}$ equal to 27 *l.* 15 *s.* 7 *d.* $\frac{1}{2}$. $\frac{5}{12}$.

The Proof of this Queſtion by the *Rule of Three Direct.*

The PROOF.

l.		*l.* : *s.* : *d.*		*l.* : *s.* . *d.*
1	———	5 : 5 : 5	———	5 : 5 . 5
20		20		20
20		105		105
12		12		12
0		1265		1265
				1265
				6325
				7590
				2530
				1265
				1600225

```
                      12
240)1600225(6667(55|5
      1440····  60      ———
     ——————   ————— 27|15 : 7 : 29/48 = 1/2 + 7/12
       1602     66
       1440     60
       ————   ————
        1622    67
        1440    60
        ————  ————
         1825    7
         1680   ——
         ————
          145
         ————
```

$\frac{145}{240}\Big|\frac{29}{48}$.

By the ſtating any Queſtion in this Kind (by t *Rule of Three)* all thoſe Queſtions of multiplyi Money by Money, are both eaſily comprehend and anſwered.

Again, Multiply 5 *l.* 19 *s.* 6 *d.* by 5 *l.* 19 *s.* 6 by the *Rule of Three.*

```
 l.           l.  :  s.  :  d.           l.  :  s.  :  d
 1 ——————————— 5  :  19  :  6 ——————————— 5  :  19  :  6
20            20                        20
——          ————                      ————
20           119                       119
12            12                        12
——          ————                      ————
240         1434                      1434
———         ————                      ————
```

240——1434——1434

1434

5736

4302

5736

1434

2056356

$$\begin{array}{l} 12 \\ 24|0)205635|6(8568(71|4 \\ 192\cdots \qquad \cdots \\ 136 \qquad 0\ 35|14 : 0+\frac{1}{8}. \\ 120 \\ 163 \\ 144 \\ 195 \\ 192 \\ 3 \qquad 2\frac{3}{4}|\frac{1}{8}. \end{array}$$

Some few Examples more for the right under-
anding of this Sort of Multiplication, now very
uch in Uſe.

Let 75 Feet, 9 Inches be multiplied by 17 Feet, 7 Inches.

```
Feet  In.      Feet  Inches
 75 : 9   by    17 : 7
  17
 ———
 525
 75
 ————
1275
  12 :  9
  43 : 10
   1 :  4
 —————————
1332 : 11      Anſwer, 1332 Feet, 11 Inches.
```

Explanation.

Multiply croſs-wiſe, *viz.* 17 by 9 makes 12 *In.* 9 *pts,* 75 by 7 makes 43 *In.* 10 *pts.* and the Fraction 7 Inches, and 9 Inches being added. makes 16, and divided by 12, *facit* 1 *Foo.* 4 *pts.*

```
        Feet   Inches   Feet  Inches
Laſtly   179  :  3   by   38 : 10
          38  : 10
         ————
         1432
         537
         —————
         6802
          149 : 2 }
            9 : 6 } Croſs-wiſe.
            1 : 1   Fraction makes.
         ——————
         6961 : 9   Anſwer, 6961 Feet, 9 Inches.
```

Diviſion of Vulgar Fractions.

The RULE.

WHEN the Numbers given are both ſingle Fractions, multiply the Denominator of the Diviſor by the Numerator of the Dividend, ſo is the Product a new Numerator. Alſo multiply the Numeator of the Diviſor by the Denominator of the Dividend, ſo is the Product a new Denominator, which new Fraction is the Quotient ſought.

As for EXAMPLE.

Queſt. 1. Divide $\frac{3}{4}$ by $\frac{2}{5}$ $\frac{2}{5})\frac{3}{4}(\frac{15}{8}$ or 1. $\frac{7}{8}$.

Queſt. 2. Let $\frac{5}{8}$ be divided by $\frac{2}{7}$ $\frac{2}{7})\frac{5}{8}(\frac{35}{16}$ or 2. $\frac{3}{16}$:

Queſt. 3. Divide 42 by 7. $\frac{1}{2}$, that is divide $\frac{2}{1}$ by $\frac{15}{2}$.

$\frac{15}{2})\frac{42}{1}(\frac{84}{15}$ or 5. $\frac{3}{5}$.

Queſt. 4. In like Manner if *6.* $\frac{1}{2}$ be divided by . $\frac{2}{5}$, the Quotient will be 1. $\frac{31}{34}$.

$\frac{17}{5})\frac{13}{2}(\frac{65}{34}$ or 1. $\frac{31}{34}$.

Queſt. 5. Alſo if 5. $\frac{1}{3}$ be divided by 12. $\frac{1}{2}$, the Quotient will be $\frac{32}{75}$.

Queſt. 6. If 12 be divided by $\frac{2}{5}$ and $\frac{1}{10}$, the Quotient will be 24.

Add $\frac{2}{5}$ $\frac{1}{10}$ 10
5
$\frac{1}{2})\frac{12}{1}(\frac{24}{1}$ 20
5 50
$\frac{25}{50}$. *Facit* $\frac{25}{50}|\frac{5}{10}|\frac{1}{5}$.

Queſt. 7. I demand the Quotient of $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$, divided by $\frac{2}{3}$ of $\frac{1}{2}$.

Thus $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ *Facit* $\frac{6}{24}$ or $\frac{1}{4}$.
And $\frac{2}{3}$ of $\frac{1}{2}$ makes $\frac{2}{6}$ or $\frac{1}{3}$.

Thus$)\frac{1}{3}(\frac{1}{4}(\frac{3}{4}$ for Anſwer.

Queſtions to exerciſe the Rules of Vulgar Fractions before delivered.

Queſtion the firſt.

The Difference of two Numbers is 1. $\frac{13}{24}$, the leſſer Number is 2. $\frac{1}{8}$, what is the greater?

Anſwer 3. $\frac{2}{3}$. found by *Addition*.

Thus add $\frac{37}{24}$ to $\frac{17}{8}$

704
$\frac{37}{24}$ X $\frac{17}{18}$
192

192)

$$\begin{array}{l} 192)704(3.\ \frac{128}{192}=\frac{2}{3}. \\ \quad 576 \\ \hline \quad 128 \end{array}$$

Abbreviation.

$\frac{128}{192} \Big| \frac{64}{96} \Big| \frac{32}{48} \Big| \frac{16}{24} \Big| \frac{8}{12} \Big| \frac{4}{6} \Big| \frac{2}{3}.$

Queſt. 2. What Number is that which if added o 3. $\frac{5}{8}$ gives the Sum 8. $\frac{23}{88}$.

Anſwer, 4. $\frac{7}{11}$ by *Subtraction.*

3. $\frac{5}{8}$
$\frac{29}{8}$

Thus 8. $\frac{23}{88}$ is $\frac{727}{88}$.

$\frac{29}{8}$ from $\frac{727}{88}$

$$\begin{array}{ccc} 2552 & & 5816 \\ \hline \frac{29}{8} & \times & \frac{727}{88} \\ \hline & 704 & \end{array} \qquad \begin{array}{ll} 5816 & \\ 2552 & \text{ſubt.} \\ \hline 3364 & \text{Reſt} \\ \hline \end{array}$$

704)3264(4. $\frac{7}{11}$ for Anſwer.

Abbreviation.

$\frac{448}{704}\ \frac{224}{352} \Big| \frac{112}{176} \Big| \frac{56}{88} \Big| \frac{7}{11}$

There is in 3 Bags the Sum of 121. $\frac{2}{40}$ Pounds, *viz.* in the firſt Bag 50. $\frac{5}{8}$, in the ſecond 40. $\frac{4}{15}$, what is in the third Bag? Found by *Addition* and *Subtraction.*

Thus,

$$\begin{array}{cc} 6075 & 4832 \\ \hline 50.\ \frac{5}{8} & 40.\ \frac{4}{15} \\ \hline 120 & \end{array}$$

Add $\frac{6075}{120}$ to $\frac{4832}{120}$:

120)10907(90. $\frac{107}{120}$.
1080

107

6075
4832 add

10907

Then take $\frac{90}{1}$. $\frac{107}{120}$ from 121. $\frac{9}{40}$.

Thus

120
107 ſub.

13

1080

520 from 121. $\frac{9}{40}$

$\frac{13}{120}$

4800

40
13 mult.

120
40

520

Then take 520 from 1080, reſt $\frac{560}{4800}$.

$\frac{560}{4800} | \frac{280}{2400} | \frac{56}{480} | \frac{28}{240} | \frac{14}{120} | \frac{7}{60}$.

Then from $\frac{121}{90}$. $\frac{9}{40}$

Remains 30. $\frac{7}{60}$.

Here you may obſerve, That by reaſon the fractional Part of the mixt Number to be ſubtracted, is greater than the fractional Part of the mixt Number, from which you are to ſubtract, as here $\frac{107}{120}$ is greater than $\frac{9}{40}$; then you muſt ſubtract the ſaid greater Fraction from an Integer, borrowed from the greater mixt Number, as by the Rule before taught.

Queſt. 4. Two Merchants *A.* and *B.* have cern Shares in a Ship, the Share of *A.* is $\frac{7}{10}$ of the ip, that of *B.* $\frac{9}{13}$, what is the Difference between eir Parts ?

Anſwer, the Share of *A.* exceeds the Share of *B.* $\frac{1}{130}$.

Thus found.

$$\begin{array}{ccccc} & 21 & & \frac{20}{1} & \\ A. & & \mathbf{X} & & B. \\ & \frac{7}{10} & & \frac{9}{13} & \\ \hline & & 130 & & \end{array} \qquad \text{Take } \begin{array}{r} 91 \\ 90 \text{ ſub.} \\ \hline 1 \end{array}$$

$\frac{1}{130}$.

What is $\frac{5}{8}$ of 130. $\frac{2}{3}$.

Anſwer, 81. $\frac{2}{3}$.

Found by Multiplication thus :

$\frac{5}{8}$ of $\frac{392}{3}$ is $\frac{1960}{24}$

```
24)1960(81. 2/3
   192··
   ———
    40
    24
   ———
    16
   ———
```

$\frac{16}{24} \Big| \frac{8}{12} \Big| \frac{4}{6} \Big| \frac{2}{3}$

Queſt. 6. What Number is that, which being tiplied by $\frac{3}{5}$ produceth 25. $\frac{2}{5}$.

Anſwer, 42. $\frac{1}{3}$.

Queſt.

Found by Diviſion thus,

Divide 25. $\frac{2}{5}$ by $\frac{3}{5}$.

$\frac{3}{5})\frac{127}{5}(\frac{635}{15}$

$$\begin{array}{l} 15)635(42.\frac{1}{3} \\ \quad\; 60\cdot\cdot \\ \hline \quad\; 35 \\ \quad\; 30 \\ \hline \quad\;\; 5 \\ \hline \end{array}$$

$\frac{5}{15}|\frac{1}{3}$

Theſe Queſtions was deſired to be worked.

The Rule of Three Direct in Fractions.

TO work this Rule you muſt multiply the Denominator of the firſt Number, by the Numerator of the ſecond; then multiply that Product by the Numerator of the third Number, and reſerve this Product for a new Numerator; that done multiply the Numerator of the firſt Number, by the Denominator of the ſecond; alſo multiply this Product by the Denominator of the third, ſo ſhall this Product be a new Denominator. Laſtly, this new Fraction ſo ſought is the Anſwer to the Queſtion, which ſaid Fractions, whether proper, improper or mixt Fractions, may be reduced into its equivalent Fractions as before taught.

A

As for EXAMPLE.

If $\frac{3}{4}$ of a Yard coſt $\frac{5}{6}$ of a Pound what will $\frac{7}{8}$ of a Yard?

5	3
20	18
7	8
140 Numerator	144 Denom.

$\frac{140}{144}|\frac{70}{72}$.

$\frac{3}{4}$ ———— $\frac{5}{6}$ ———— $\frac{7}{8}$

Anſwer $\frac{140}{144}$ or $\frac{70}{72}$.

Which ſaid $\frac{70}{72}$ being reduced into Shillings, Pence, d Farthings makes 19 *s.* 5 *d.* $\frac{1}{4}$.

Queſt. 2, If $\frac{3}{4}$ of a Pound of Cinnamon be ſold or 1 *s.* $\frac{1}{8}$ what coſt $\frac{1}{2}$ ℔.

$\frac{3}{4}$ ———— $\frac{9}{8}$ ———— $\frac{1}{2}$

Anſwer, $\frac{3}{4}$ *l.*=9 *d.*

9	Thus 3
36	8
1	24
	2
36 Num.	48

$\frac{36}{48}|\frac{18}{24}|\frac{9}{12}|\frac{3}{4}$ of a Pound Sterling, which is 9 *d.*

Queſt 3. If $\frac{3}{4}$ of a Yard coſt $\frac{4}{9}$ of a Pound Sterling, what coſt $\frac{5}{8}$ of a Yard.

Yard ℔ *Yard.*

$\frac{3}{4}$ ———— $\frac{4}{9}$ ———— $\frac{5}{8}$

4 3 Anſwer $\frac{10}{27}$ = 7 *s.* 4 *d.*

16 27

5 8

80 **Num.** 216 **Denom:**

$2\,\frac{80}{216} \big| \frac{40}{108} \big| \frac{20}{54} \big| \frac{10}{27}$

Queſt. 4. If $\frac{2}{3}$ of a Pound buy $\frac{5}{6}$ Yards of Cloth, what will $\frac{11}{12}$ of a Yard coſt at that Rate?

Stated thus :

Yard *l.* *Yard*

$\frac{5}{6}$ ———— $\frac{2}{3}$ ———— $\frac{11}{12}$

2 5

12 15 Anſwer $\frac{11}{15}$ = 14:

11 12

132 Num. 180 Denom.

Anſwer $\frac{132}{180} \big| \frac{66}{90} \big| \frac{22}{30} \big| \frac{11}{15}$

Queſt. 5. If 3 Yards of broad Cloth coſt 2 *l.* what will 14. $\frac{3}{7}$ Yards coſt?

Yard *l.* *Yards*

$\frac{3}{1}$ ———— $\frac{14}{5}$ ———— $\frac{101}{7}$ coſt.

3 101

5 14

$\frac{105}{1414}$ of a Pound, equa

15 404 to 13 *l.* 9 *s.* 4 *d.*

7 101

105 1414

Thu

Thus proved, by reducing your Fractions as be- e taught.

105)1414(13 *l.* 9 *s.* 4 *d.*
105
364
315
49
20
105)980(9 *s.*
945
35
12
105)420(4 *d.*
420
0

Thus you ſee as by the Operation, that $\frac{105}{1414}$ al to 13 *l.* 9 *s.* 4 *d.*

Queſt. 6. if 1 *l.* of Cochineal coſt 25 *s.* what 36 *l.* $\frac{7}{10}$ of Cochineal.

℔. s. ℔
$\frac{1}{1}$ —————— $\frac{25}{1}$ —————— $\frac{367}{10}$

$\frac{1}{10}$

367
25
1835
734
9175

$\frac{175}{10}$ $\frac{1835}{2}$ = 45 *l.* 17 *s.* 6 *d.* *For,*

For,

$$2)1835(91|7\ s.$$

$$\tfrac{1}{2}\ 45|17 : 6\ d.$$

Queſt. 7. If 1 Yard coſt 9 *s.* what coſt 4 Yards

Anſwer, $\frac{261}{6}$ = 43 *s.* 6 *d*

$$\frac{1}{1}\text{————————}\frac{9}{1}\text{————————}\frac{29}{6}$$

$$\begin{array}{ccc} 6 & \underline{} & \\ \hline 6 & 9 & \\ & \frac{29}{261} & \frac{261}{6} \end{array}$$

$$\begin{array}{l} 6)261(43\ s.\ \tfrac{1}{2} \\ 24 \\ \hline 21 \\ 18 \\ \hline 3 \end{array}$$

Queſt. 8. If a Quantity of Amber-greaſe weig ing 1. $\frac{5}{7}$ ℔ *Troy*, be ſold for 60 *l. Sterling*, what w 19 ℔. $\frac{5}{8}$ *Grains* worth at that Rate?

$$\begin{array}{ccc} ℔. & l. & ℔.\ gr. \\ 1.\ \frac{5}{7}\text{————} & \frac{60}{1} & \text{————}19.\ \frac{5}{8} \end{array}$$

Or reduced into improper Fractions.

$$\begin{array}{ccc} ℔. & l. & grs. \\ \frac{12}{7}\text{————} & \frac{60}{1} & \text{————}\frac{157}{8} \end{array}$$

Note, The third Number muſt be reduced into Fraction of a Pound *Troy*, thus $\frac{157}{8}$ Grains are of $\frac{1}{24}$ of $\frac{1}{20}$ of $\frac{1}{12}$ of a Pound *Troy*, which compou Fraction being reduced into a ſingle Fraction,

$\frac{157}{46080}$ Pounds *Troy*, and then the three Numbers e brought into a Rule.

Thus,

```
 ℔            l.                   grains
 12 ——————————60————————————————————157
 —            —                    ——————
 7            1                    46080
                                      12
                                   ——————
              60                   92160
               7                  46080
            ————                 ———————
             420                  552960 Deno.
             157                 ———————
           —————
            2940
           2100
           420
          ——————
          65940 Num.
          ——————
```

$\frac{65940}{552960}$ = 2 *s.* 4 *d.*—$\frac{119}{192}$:

Queſt. 9. When the $\frac{2}{5}$ of $\frac{3}{4}$ of a Ship is valued 147 *l.* 11 *s.* 3 *d.* how much is the whole Ship orth ?

By converting the 147 *l.* 11 *s.* 3 *d.* into Pence, e three Numbers will ſtand thus :

```
    Ship             Pence              Ship
 If 3/10 ————————————35415——————————————1/1
                      10
                     354150
                      —     l.    s.   d.
          Anſwer,   3=491  :  17  :  6

                                 3)354150
```

12

3)354150(118050(983|7

108 —— | —— *d.*

—— 491|17 : 6

100

96

——

45

36

——

90

84

——

6

Queſt. 10. If 3 Yards of broad Cloth coſt 2 *l.* what will 14. $\frac{3}{7}$ of Yards ?

d.

$\frac{3}{1}$ —————— $\frac{672}{1}$ —————— $\frac{101}{7}$

672 3

101 ——

—— 3

672 27

6720 ——

—— 21 Denom.

67872 Num.

——

12

21)67872(3232(26|9

—— | ——

0 4 13|9 : 4

2. $\frac{4}{5}$ is 56 Shillings, which is 672 Pence.

Anſwer, 13 *l:* 9 *s.* 4 *d.*

The Inverſe, or Backward Rule of Three in Fractions.

AFTER a Queſtion belonging to this Rule is duly ſtated and prepared, the Operation Rule will be thus:

The RULE.

Multiply the Denominator of the third Fraction, the Numerator of the ſecond. Alſo multiply at Product by the Numerator of the firſt Fraction, d reſerve the Product for a new Numerator.

Again, multiply the Numerator of the third Fra- on by the Denominator of the ſecond; alſo multiply is Product by the Denominator of the firſt Fra- on, ſo is the laſt Product a new Denominator, ſo is new Fraction is the fourth Number ſought.

As for EXAMPLE.

Queſt. 1. If $\frac{1}{4}$ of a Yard of Cloth that is 2 Yards de will make a Garment, how much of any other apery that is $\frac{3}{5}$ of a Yard wide will make the ſame rment.

Yards. Anſwer 2. $\frac{1}{2}$ Yards.

—— $\frac{2}{1}$ —— $\frac{3}{5}$

5 3
2 1 $\frac{30}{12}$ Anſwer.

10 3 *Facit* 2 Yards $\frac{1}{2}$.
3 4

30 Num. 12 Denom.

T *Queſt.*

Queſt. 2. Suppoſe when Wheat is at 40 *s.* and 6 *d.* a Quarter, the Penny Wheat-Loaf ought to weigh 8 Ounces and 1. $\frac{5}{19}$ Penny-weight *Troy*, what ought it to weigh, when Wheat is at 36 Shillings a Quarter?

s.	*d.*	*oz.*	*pwt.*		*s.*
40 :	6 ——	8 :	1 :	$\frac{5}{19}$ ——	36
12		20			12
486		161			432
		19			1
		1454			
		161			
		3064			

$\frac{486}{1}$ —— $\frac{3064}{19}$ —— $\frac{432}{1}$

Then according to Rule.

3064	19
486	1
18384	19
24512	432
12256	38
	57
	76
1489104 Dividend	8208 Diviſor.

20 *Ounces.*
8208)1489104(181(9 : 1 *Pennyweight* 10 *Grains* $_5\frac{54}{13}$.
8208.... 180
66830 1
65664

oz. *pwt.* *grs.*
Anſwer, 9 : 1 : 10=$_5\frac{54}{13}$.

11664
8208
3456

Queſt. 3. If $\frac{5}{6}$ of a Yard of Cloth in Length, nd 1 Yard $\frac{3}{4}$ Broad, make a Child's Coat, how uch Stuff will make the Child a Coat, when the tuff is but $\frac{3}{4}$ of a Yard Broad.

$\frac{7}{4}$——————$\frac{5}{6}$——————$\frac{3}{4}$

3 4
6 5
18 20
4 7
72 Denom. 140 Num.

72)140(1. $\frac{17}{18}$ or 3 *qrs.* 3 *nails.* $\frac{1}{9}$.
72
68

Yd *qrs.* *nails.*
Anſwer, 1 : 3 : 3—$\frac{1}{9}$.

$\frac{68}{72}|\frac{34}{36}|\frac{17}{18}$

Queſt. 4. If of Cloth which is 1 Yard $\frac{1}{4}$ Broad, and 3 Yards $\frac{1}{2}$ in Length, will make a Cloak, how much in Length of that Cloth, which is $\frac{5}{8}$ Yards in Breadth will make a Cloak of the ſame Bigneſs with the former ?

Breadth *Length* *Breadth*

$\frac{7}{4}$ ——————— $\frac{7}{2}$ ——————— $\frac{5}{8}$

$$\begin{array}{lcc} & 4 & \\ & \overline{8} & 7 \\ & 5 & \underline{7} \\ & \overline{} & 49 \\ \text{Diviſor} & 40 & \underline{8} \\ & & 392 \ \text{Dividend.} \end{array}$$

40)392(9 : $\frac{4}{5}$ or 3 : $\frac{1}{5}$.
360
——
32
——

$\frac{32}{40}$|$\frac{16}{20}$|$\frac{8}{10}$|$\frac{4}{5}$.

Yards qrs.
Anſwer, 9 : 3 : $\frac{1}{5}$.

* * *

CHA

CHAP. XXIV.

Of the Reduction of Vulgar Fractions into Decimals.

1. THE Arithmetick of whole Numbers, and broken Numbers commonly called *Vulgar Fractions*, I have with much Perſpicuity, Plainneſs and Demonſtration fully explained. Come we now to that excellent Invention of *Decimal Arithmetick*, of which, who was the firſt that brought it to Light, is hard to determine. But the great Improvement it hath arrived to within theſe few Years, comes now to be fully known.

2. The Uſe of it is beſt known to thoſe, who can apply it to the practical Uſe of the Mathematicks, and for the computing of Compound Intereſt.

3. A *Decimal Fraction* is ſuch a one, whoſe Denominator is underſtood, and therefore need not be expreſſed, by Reaſon that the Decimal Parts are only eparated and known from whole Numbers by a Point or Comma, and take their Diſtance below the Units, owards the Right-hand; for as whole Numbers do ncreaſe the Value towards the Left-hand, by the ike Proportion, as you may ſee in the Following Table.

The TABLE.

Whole Numbers.	Decimal Parts.
0 Units Place,	6 Parts of 1000000
1 Tens,	5 Parts of 100000
2 Hundreds,	4 Parts of 10000
3 Thouſands,	3 Parts of 1000
4 Tens of Thouſands,	2 Parts of a Hundred
5 Hundreds of Thouſands.	1 Parts of Ten or $\frac{1}{10}$.

4. From this Table it does plainly appear, Th as whole Numbers do increaſe or become great from the Units Place towards the Left-hand, by ten-fold Proportion; ſo Decimal Parts do decrea or become leſs from the Units Place towards th Right-hand in the ſame Proportion, *viz.* by Tens

5. *Decimal Arithmetick* and its Parts are written in o Line, and are diſtinguiſhed by prefixing a Comm or Point before (to wit on the Left-hand) ſo $\frac{5}{10}$ ma be writen thus, .5 or ,5, and $\frac{25}{100}$ and $\frac{56}{1000}$ thus .00 And as in Integers, every Degree from the Unit increaſed toward the Left-hand, ſo in Decimal Par every Degree is diminiſhed toward the Right-han

6. A Decimal Fraction of Coin may be eaſily lued without the Help of Tables; for each Unit

he firſt Place is valued at 2 times the Figure in Shillings, the Figure 5, in the ſecond Place 1 *s.* and the eſt Farthings. Laſtly, when 5 is taken from the Figure in the ſecond Place, if every Unit in the Remainder be accounted as ten, and the Figure in he Remainder be accounted as ten, and the Figure n the third Place as Unities, theſe Tens, and Unities taken as one Number, and leſſened by 1 give he Number of Farthings.

s. *d.*
So .854 is in Value 17 : 1.
.418 is in Value 8 : 4. ^{1}

s. *d.*
So .8687 is 17 : 4 : $\frac{1}{4}$
.319 is 6 : 4 : $\frac{1}{2}$

s. *d.*
So .374 is 7 : 5
.7960 is 15 : 11

Thus proved,

$$\left.\begin{array}{r}8687\\20\end{array}\right\}\text{multiply}$$

$$\begin{array}{r|l}17&3740\\&12\\\hline 4&4880\\&4\\\hline 1&9520\end{array}$$

The TABLE *of Reduction.*

Of *English* Money, the Integer being a Pound *Sterling*; Table the first.		*Pence with Farthings.*			
Shillings.	*Decimals of a Pound.*				
19	. 95		. 0489583		. 0197916
18	. 9		. 0479166		. 01875
17	. 85		. 046875		. 0177708
16	. 8	11	. 0458333	4	. 0166666
15	. 75		. 0447916		. 015625
14	. 7		. 04375		. 0145833
13	. 65		. 0427082		. 0135416
12	. 6	10	. 0416666	3	. 0125
11	. 55		. 040625		. 0114583
10	. 5		. 0395833		. 4104166
9	. 45		. 0385416		. 009375
8	. 4	9	. 0375	2	. 0083333
7	35		. 0364583		. 0072916
6	. 3		. 0354166	*far*	. 00625
5	. 25		. 034375	1 *Pen.* 1	. 0052083
4	. 2	8	. 0333333	*Penny*	. 0041666
3	. 15		. 0322916	3 *farth*	. 003125
2	. 1		. 03125	2 *farth*	. 0020833
1	. 05		. 0302083	1 *farth*	. 0010416
		7	. 0291666		
			. 028125		
			. 0270833		
			. 3260416		
		6	. 025		
			. 0239583		
			. 0229166		
			. 021875		
		5	. 0208333		

f the Reduction f Inches, &c. un- o *Decimals*, the nteger being a Foot in length.

hes.	*Decimals of a Foot.*
11	.9166666
10	.8333333
9	.75
8	.6666666
7	.5833333
6	.5
5	.4166666
4	.3333333
3	.25
2	.1666666
1	.0833333
uar- ers of Inch.	*Decimals of a Foot.*
3	.0625
2	.0416666
1	.0208333
	.0104166

Of Time; a Day being the Integer.

Hours.	*Decimals of a Day.*
23	.9583333
22	.9166666
21	.875.
20	.8333333
19	.7916666
18	.75
17	.7083333
16	.6666666
15	.625
14	.5833333
13	.5416666
12	.5
11	.4583333
10	.4166666
9	.375
8	.3333333
7	.2916666
6	.25
5	.2083333
4	.1666666
3	.125
2	.0833333
1	.0416666.

The Table of TIME continued.

Minutes.	*Decimals of a Day.*
59	.0409722
58	.0402777
57	.0395833
56	.0388888
55	.0381944
54	.0375
53	.0368055
52	.0361111
51	.0354166
50	.0347222
49	.0340277
48	.0333333
47	.0326388
46	.0319444
45	.0312500
44	.0305555
43	.0298611
42	.0291666
41	.0284722
40	.0277777
39	.0270833

38	. 0263888
37	. 0256944
36	. 0249999
35	. 0243055
34	. 0236111
33	. 0229166
32	. 0222222
31	. 0215277
30	. 0208333
29	. 0201388
28	. 0194444
27	. 01875
26	. 0180555
25	. 0173611
24	. 0166666
23	. 0159722
22	. 0152777
21	. 0145833
20	. 0138888
19	. 0131944
18	. 0125
17	. 0118055
16	. 0111111
15	. 0104166
14	. 0097222
13	. 0090277
12	. 0083333
11	. 0076388
10	. 0069444
9	. 00625
8	. 0034722
7	. 0048611
6	. 0041666
5	. 0034722
4	. 0027777
3	. 0020833
2	. 0013888
1	. 0006944

Of *Liquid-Measures* the Integer being a Gallon.

Pints.	*Decimals of 1 Gallon.*
7	. 875
6	. 75
5	. 625
4	. 5
3	. 375
2	. 25
1	. 125

Quarters of a Pint.	*Decimals of a Gallon.*
3	. 09375
2	. 0625
1	. 03125

Of *Dry-Measures* the Integer being a Quarter.

Bushel.	*Decimals of a Quarter.*
7	. 875
6	. 75
5	. 625
4	. 5
3	. 375
2	. 25
1	. 125

Pecks.	*Decimals of a Quarter*
3	. 09375
2	. 0625
1	. 03125

Table of *Dr* *Measure* continu'd

Quarters of a Peck.	*Decimals a Quarter*
3	. 0234375
2	. 015625
1	. 0078125

Pints.	*Decimals a Quarter*
3	. 005859
2	. 003906
1	. 001953

Of *Long Measures,* one Yard or one Ell, being the Integer.

Quarters of 1 Yard or 1 Ell	*Decimals 1 Yard or 1 Ell.*
3	. 75
2	. 5
1	. 25

Nails.	*Decimals 1 Yard 1 Ell.*
3	. 1875
2	. 125
1	. 0625

Quarters of 1 Nail.	*Decimals 1 Yard 1 Ell.*
3	. 046875
2	. 03125
1	. 015625

To Reduce Vulgar Fractions into Decimals, add phers at Pleaſure to the Numerator, and divide the Denominator.

So $\frac{5}{8}$ being propounded to be reduced to a Decimal, ll be changed into ·625, that is $\frac{625}{1000}$ for annex- g Cyphers unto the Numerator 5, it will be 5000, ich being divided by the Denominator 8, the uotient will be 625, before which, prefixing a int it will be .625 that is .$\frac{625}{1000}$ the Decimal ſought, you may ſee in the Margin.

```
5000(625
48··
——
 20
 16
——
  40
  40
——
   0
```

Alſo $\frac{1}{4}$ will be reduced into the Decimal .25 (or $\frac{25}{100}$.)

```
Thus, 4)100(25, or 25/100.
          8··
         ———
          20
```

Reduce $\frac{4}{5}$ into a Decimal Fraction.

5)4000(800 *Facit* .800 or $\frac{800}{1000}$.

Having before in the ſixth Paragraph ſhewn in a rief Way, the diſcovering of a Pound *Sterling* into ounds, Shillings, Pence, and Farthings.

I proceed to ſhew you to reduce the Decimal of a ound *Troy-weight*, *viz.* .86462 *l.* into known Parts, rſt, I multiply it by 12, becauſe 12 Ounces is a ound, and then by 20, becauſe 20 Penny-weight is n Ounce, and then by 24, becauſe 24 Grains makes Penny-weight; and when you have ſo done, by cutng off the two firſt Figures of the Left-hand, I find e Value of the given Decimal .86462 Pounds *roy-weight* to be as in the Margin.

So

```
So   86462
        12
   -------
 10|37544
       20
   -------
 07|50880
       24
   -------
   203520
  101760
   -------
 12|21120
   -------
```

So that I conclude th Value of the given D cimal .86462 Pound *Tr weight* to be 10 *oz.* 7 *Pe ny-weight*, 12 *Grain* .21120. The ſame is t be obſerved in findi the Value of any oth Decimal whatſoever whether of Coin, Weigh Meaſure or Time.

I might here have added ſeveral Tables of *Red ction*, ſhewing the Decimal Parts of any Parts Money, Weight, Meaſure, or Time, as divers Autho have done; but becauſe tho' they are thus uſef yet they are ſeldom made uſe of, by Reaſon of th Eaſe in finding the Equivalent Decimal of any Fr ction whatſoever, I ſhall forbear the making the but proceed to the Uſes of *Addition*, *Subtracti Multiplication*, and *Diviſion* in *Decimals*, which w be as eaſy as the Operations in whole Numbers.

* * *

Addition of Decimal Fractions.

AS for the Operations of *Addition* and *Subtra ction*, they are the ſame as in whole Number there muſt only care be had of ſetting Units und Units, and Fractions under Fractions, in their p per Ranks and Files, as likewiſe, that there be many Places of *Fractions* in the Total, as are fou in either of the Sums, before they are add together.

As for EXAMPLE.

To 375 : 42	To 375 : 42
Add 495 : 4	Add 95 : 03
Sum 870 : 82	Sum 470 : 45

f theſe mixt Numbers, to wit 32 .056, 7.07, and 9 were given to be added, they muſt be done, s ranked,

32 .056	.65	24 .7	503 .75
7 .07	.025	0 .35	0 .32
1 .9	.03	5 .26	0 .12
41 .026	.705	30 .31	504 .19

Add

29 .93229	.3
63 .55937	.752
129 .20201	.098
3 .39371	.05
	.926
226 .08745	.83
	2 .956

Here you may obſerve, That the Number of ens (if there be any contained in the firſt Place of e Decimals, being that next unto the Points) is e Number of Integers to be carried to the Place Units or Integers.

Subtraction of Decimals.

BE ſure to place the *Decimals* as is directed the laſt Chapter, and then you may procee as you are taught in *Subtraction* of whole Numbers

Examples hereof are theſe that follow,

From	872	.82	From	470	.45
Take	495	.4		95	.03
Reſt	377	.42		375	.42

But here when the *Decimals* conſiſt not of eq Places towards the Right-hand, ſupply that Defe by annexing Cyphers, or at leaſt by ſuppoſing C phers to be annexed to thoſe *Decimals*.

As for EXAMPLE.

24	.04338	37	.	.394	.65
	.65	0	.104	.35	.04338
23	.39338	36	.104	.044	.60662

ultiplication of Decimal Fractions.

The RULE.

O often as two Numbers are given to be multi-
plied, and are both mixt Numbers, or both
imal Fractions, or one of them a whole Number,
the other a *Decimal* or mixt Number, write
m down exactly one under the other, as is done
Multiplication of whole Numbers; and when you
e gotten the Product, ſee how many Places of
ctions are found both in the Multiplicand and
ltiplicator jointly, juſt ſo many Places you muſt
off from the Product, by a Point, Comma,
Line towards the Right-hand, as there are
ces of *Decimals* in both the Multiplicator and Mul-
lier.

As for EXAMPLE.

Multiply	246.25	.87
By	35	.9
	123125	.783
	73875	
	8618.75	

Multiply 342.34
By 3.123

102702
68468
34234
102702

Product 10691.2782

.2342
.32

4684
7026

7.4944

When the *Multiplication* is finiſhed, if there ar not ſo many Places in all, as ought to be cut o (which may often happen, when the Product is Fraction ;) in ſuch Caſe, as many Places as are wan ing, ſo many Cyphers muſt be prefixed to the Pr duct on the Left-hand thereof, to complete t Product.

As in theſe Examples.

Multiply .0375 by .05

.0375
.05

1875

Now here being but four Figures, I prefix t Cyphers to complete the Product, ſo that the t Product of

Multiply .0375 is .001875 Product.
By .05

Product is .001875 as by the Rule.

In like Manner, multiply this mixt Number 5.525 by .0026.

Thus,

5.525
.0026

33150
11050

.0143650 Product

* * *

Diviſion of Decimal Fractions.

N *Diviſion of Decimals*, the greateſt Difficulty is to
know, of what Nature the firſt Figure or Cy-
er in the Quotient ought to be; for that being
own, all other Operations are the very ſame, as
the ordinary Way in the working *Diviſion* in whole
umbers.

N. B. Therefore, I ſhall give this general Rule
the finding of what Queſtion ſoever, as ſhall be
in any of the Kinds whatſoever, therefore mark
igently the Rule.

> For *Decimal Parts* there muſt be as many Places in the Diviſor and Quotient, as are in the Dividend.

o illuſtrate this Rule, I ſhall give Examples in
the Caſes.

Firſt, Let 7.4944 be given to be divided by 3

The Work ſtands thus:

```
32)7.4944(.2343
   64....
   ---
   109
    96
   ---
    134
    128
    ---
     64
     64
     --
      0
     --
```

Now according to the Rule, by Reaſon the are four *Decimal* Parts in the Dividend, there mu be as many Places in the Diviſor and Quotien therefore the Point falls before .2342 on y Left-hand

Examp. 2. Suppoſe this mixt Number 9746.2 divided by 32.4, the work will ſtand thus:

```
32.4)9746.2(3.00
     972...
     ---
       262
       ---
```

The *Diviſion* being done as in whole Numbers, length theſe Figures will ariſe in the Quotient, wi 300, and according to your Rule, I find the Figure ſtands in the Unit's Place, and the Q tient is at length diſcovered to be as afore-writte

Ex

Examp. 3. Divide 48 by 43796, Now you perceive the Dividend 48, cannot be divided by 4376 you muſt therefore increaſe your Dividend with Cyphers at Pleaſure after this Manner 48.000000, and work as in whole Numbers, before you can tell where the Units Place will fall.

Thus.

```
43796)48.000000(1095
      43796····
      ─────────
      420400
      394164
      ─────────
       262365
       218980
       ─────────
        43385
        ─────
```

Now to find out its true Value, conſider that here are no *Decimal* Places in the Diviſor, but there re Six in the Dividend; therefore there muſt be ſix *Decimal* Places in the Quotient (according to your ule) therefore you muſt prefix on the Left-hand of our Quotient two Cyphers before the Figures 1095. o will the true Quotient appear to be thus.

$$43796)48.000000(.001095—\tfrac{43385}{43796}.$$

This Caſe by being well obſerved, may perform l the Rules in *Decimal Fractions*; however for a rther underſtanding of this Rule, I will proceed ith ſome more Examples through all Caſes.

Examp. 4. Divide 172.5 by 3.746.

Thus,

```
3.746)172.500000(46.049
      14984····
      -----
       22660
       22476
       -----
        18400
        14984
        -----
         34160
         33714
         -----
           446
```

Now it remaineth to ſeparate the Integers in this Quotient from the *Decimal* Parts, which by the due Obſervation of your Rule aforegoing, you will find that there are 3 *Decimal* Places in the Diviſor, and 6 *Decimal* Places in the Dividend, the Exceſs being 3; and conſequently 3 *Decimal* Places noted in the Quotient. So

$$3.746)172.50000(46.049-\frac{446}{3746}.$$

is the Quotient, and 446 remaineth, which is leſs in value than $\frac{1}{1000}$ Part of an Unit or Integer.

Examp. 5. Suppoſe this mixt Number 2.34 given t be divided by this mixt Number 52.125. Firſt, a before, annex Cyphers at Pleaſure to the Dividend at length theſe Figures will by the Operation ariſe.

52.12

52.125)2.3400000(.448—52.125
208500
255000
208500
465000
417000
48000

48000

Thus by the Rule there are 3 *Decimals* in the Diviſor, and 7 in the Dividend: there ought therefore to be 4 *Decimals* in the Quotient, which is to be done by putting a Cypher on the Left-hand.

51.125)23400000(.0448—52.125

48000
The true Quotient.

Examp. 6. Divide .8564 by .008 by annexing Cyphers to the Dividend at Pleaſure, the Quotient will be found to be.

008).856400(107.050

Accordingly the true Quotient is found as above or 107. $\frac{5}{1000}$.

Queſt. 7. Divide this mixt Number .73952 by .32.

Quotient is .32).73952(2.311 Anſwer

Examp. 8 Divide 14.070100(by 3.2010.

3.2010)14.070100(4.39 for Anſwer.
128040
126610
96030
305800
288090
17710

17710
3.2010

Thus having according to the beſt of my Judgment, gone through all the neceſſary Caſes that can happen in *Decimal Arithmetick* by *Diviſion*, I ſhall go on with ſome few Examples in the Rule of Proportion, and in the Menſuration of ſome ſuperficial Meaſures and Solids, before I come to ſhew more exactly their Uſe in the more difficult Parts, in the Extraction of the Square and Cube Roots.

The Rule of Three in Decimal Fractions.

IN this Rule, the Operations are the ſame in all Reſpects, as in whole Numbers; only when you work in *Decimals*, reſpect muſt be had to the *Decimal* Rules before taught, more eſpecially when you come to the Anſwer in your Quotient, by duly ſeparating the *Decimals* from the *Integers*. A few Examples will make you underſtand the Rule.

As

As for EXAMPLE.

Examp. 1. If 9 ℔. ¼ of Coffee coſt 3 *l.* 15 *s.* how uch will 278 ℔. ½ of Coffee coſt?

Note, When the fractional Parts of the Numbers n this Queſtion are converted into *Decimals,* then they vill ſtand thus.

℔ *of Coffee* *l.* *Coffee* coſt.
9.25 —— coſt 3.75 *Shill.* what will 278.5 of
3.75

13925
12495
8355

1044.375

l. *s.* *d.*
.25) 104.4375(112 . 9 . $\frac{50}{9.25}$ = 1 +
925

1193
625

2687
1850

8375
8325

50

Thus have I performed the Operation at large, nd the Anſwer is found 112 *l.* 9 *s.* 1 *d.* +

Examp. 2. If 19 Ounces, 3 Pennyweight, and 5 Grains of Gold, be worth 62 *l.* 10 *s.* 6 *d.* what is the Value of an Ounce?

Anſwer 3 *l.* 5 *s.* 3 *d.* very near.

The Terms being reduced into *Decimals*, (according as hath been taught before) the Queſtion will ſtand thus:

```
℔. Troy          l. Sterl.          ℔. Troy
1.596701————————62.525——————————.083333
                                  62.525
                                 ———————
                                  416655
                                 166666
                                416665
                               166666
                              499998
                              ————————————
                              5.210395825
                              ————————————

1.596701)5.210395825(3.263  Anſw. 3 l. 5 s. 3 d. f.
         4790103
         ———————
         4202928
         3193402
         ————————                360462
         10095262                ———————
          9580206                1.596701
         ————————
          5150565
          4790103
          ———————
           360462
          ————————
```

xamp: 3. If 9 C. of Sugar coſt 25 *l.* 7 *s.* what l be the Price of 17 C. Weight of the ſame at t Rate?

Thus ſtand,

```
C.          l.                C.
9 ———————— 25.35 ———————————— 17
           ——————
           17745
           2535
           ———————
         9)43095(47.883
           36····
           ————
            70            For Anſwer,
            63          47 l. 17 l. 8 d. fere.
            ————
             79
             72
             ————
              30
              27
              ————
               3
              ————
```

ound out by the brief Way of finding the Va- of a *Decimal* Part of a Pound *Sterling*.

The

The farther Uſe of Decimals in th Menſuration of Superficies an Solids.

Propoſition 1.

THERE is a Chamber, whoſe Floor is 22 Fee 9 Inches long, and 9 Foot 6 Inches broad what is the Content in Feet and Inches?

Decimally thus,

Length *Feet*

$\frac{125}{1000}|\frac{25}{290}|\frac{1}{8}$ 22.75 And Breadth 9 . 5 what is th Content.

95

11375

20475

216|125

Anſwer 216 Feet, and $\frac{1}{8}$ Part of an Inch.

Anſwer'd by Vulgar Arithmetick.

```
Feet Inches      Feet Inches.
 22 . 9 long by  9 : 6 broad.
 12              12
 ----            ----
  53             114
  22             ----
 -----
  273
  114
 -----
 1092
 273
273      Feet, ⅛ Part of a Foot:
-----
44)31122(216. ⅛          for 18/144|9/72|1/8.
  288··
  ----
  232
  144
  ----
   882
   864
   ---
    18
   ---
```

that you ſee this Queſtion, is anſwered both mally and after the vulgar Way in Fractions : how tedious a Work it is to anſwer it this vulgar ,I leave it to the Underſtanding Reader to judge.

Propoſition 2.

ow many Yards of Wainſcot doth that Room ire, whoſe Heighth is 12 Foot, 3 Inches, and pa∫s 104 Feet, 6 Inches?

Feet
3 in Decimals is .25
6 in Decimals is .5

Therefore multiply 104.5
By 12.25

5225
2090
2090
1045

In Feet 1280.125

To anſwer the Queſtion in Yards,

Divide by 9)1280126(142.236
9

38
36

20
18

21
18

32
27

55
54

1

Anſwer, 142.Yards, $\frac{236}{1000}$ Feet; or 142 Ya
2 Feet, 3 Inches.

Propoſition 3.

ow many Yards in a Ceiling 47.4 Inches long, 18 Feet broad ?

Decimally

4 Inches =3333 +

refore multiply 47.3333

18

3786664

473333

851.9994

Feet *Inches*

851 . $\frac{924}{1000}$

Into Yards

yds

9).851.9994(94.6666

81……

yds *Feet* *In.*

41 Anſwer, 94 : 6 : 10 : .6

36

59

54

59

54

59

54

54

54

0

Pro-

Propoſition 4.

There is a ſquare Piece of Land that is 37 what is the Content in Acres, Roods and Perches

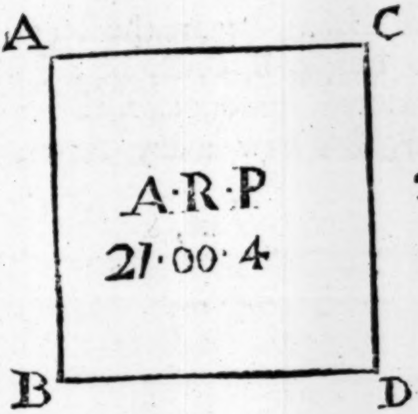
Anſwer, 8 Acres, 2 Roods, and 27 Perches

```
         37.25
         37.25  Square
        ------
        18625
        7450
       26075
      11175
     ---------
     1387.5625  Square Perches.
```

Which being reduced will give 8 Acres, 2 Roo and 27 Perches.

```
               4
40)1387.5625(34.6890(8 Acres, 2 Roods, 25 Per
   120 .....   32 ...
   ---         --
   187          2
   160
   ---
    275
    240
    ---
     356
     320
     ---
     362
     360
     ---
      ·25
```

Propoſition 5.



To Meaſure a Square —

```
     58
     58
    ----
    464
   290
  -------  4  A.  R.  P.
40)3364(84(21 : 0 : 4
   320    8
   ----  --
    164  04
    160   4
   ----  --
      4   0
   ----  --
```

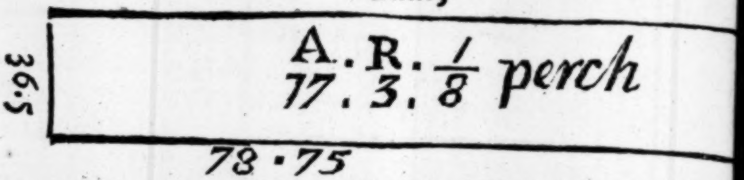
Multiply the Side by itſelf, *viz.* 58 by 58, *Facit* 64 Poles, which reduce into Acres, by dividing em firſt by 40, to bring them into Roods, and en by 4 to bring them into Acres; ſo it is und 21 Acres, 00 Roods, 4 Perches.

Propoſition

Propoſition 6.

To meaſure a Long-Square the Length and Bread being given. Let *A*, *B*, *C*, *D*, be a Long-ſquare g ven to be meaſured, whoſe Length is 78.75 Perch and Breadth 36.5, how many Acres, Roods, a Perches ?

Thus,



Multiply the Length by the Breadth, ſo have y the Content in Perches or Poles, which divide ag by 4 to bring into Acres.

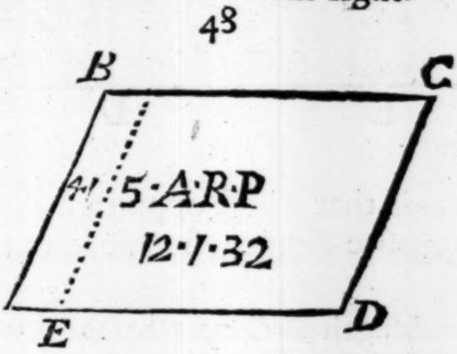
```
        Thus 78.75
             36.5
            ------
             39375
            47250
           23625
          ----- -----4
     40)2874.375(71.859(17.964
        280          4
        ---      ---
         74       31
         40       28
        ---      ---
         343      38
         320      36
        ----     ---
          237      25
          200      24
         ----     ---
          375      19
          360      16
         ----     ---
           15       3
```

Acres *Roods*
Anſwer, 17 : 3 : 15 *Perch.*

Propoſition 7.

To meaſure a Rhombus.

A Rhombus hath all its Sides equal, and oppoſite ngles equal, but none of them right.



Let *B C* be 48 Foot, and *A D* 41.5 Foot, to know Content in Acres, Roods and Perches.

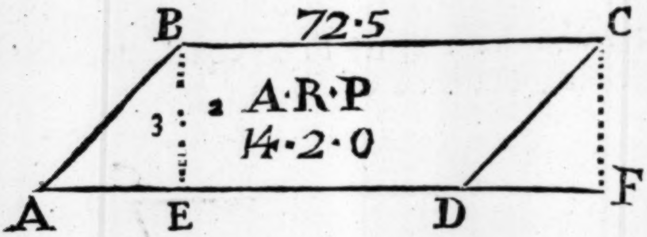
Thus,

Multiply the Side of the Rhombus *B C*, by the pendicular *E B*, and the Product ſheweth the ntent in Perches to be 1992, and in Acres, 12 A-s, 1 Rood, 32 Perches.

Thus found.

```
   48
   41.5
  ----
   48
 192
 ----
 1908
   24 add for the Fraction .5 or ½ of 48.
 ------4            R.  P.
40)1992(49(12 Acres  1 : 32
 32  1
```

Propoſition 8. Meaſuring a *Romboides.*



A *Rhomboides* is that whoſe oppoſite Sides are equal, as alſo the oppoſite Angles, but none of them right.

Multiply *the* *Length* *B C* 72.5 by the Perpendicular *A E* 32, and the Product ſheweth the Product is 1880 Poles or Perches.

Thus found,

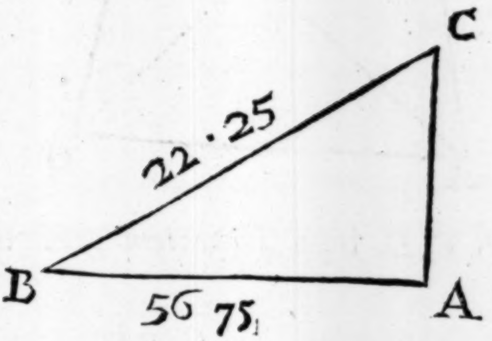
```
        72.5
         32
      ------
        144
       216
      ------
       2304
         16
     -------4    A.  R.  P.
   40)2320(58(14 : 2 : 0
      200
      ----- 2
       320
       320
      -----
         0
```

The Content is 14 Acres, 2 *Roods.*

Propoſiti

Propoſition 9.

To meaſure a Right angled **T**riangle as the △ *BAC* repreſents, in which *BA* is termed the Baſe, *CA* he Perpendicular, and the Side *BC* that ſubtends he Right Angle, the Hypothenuſe.

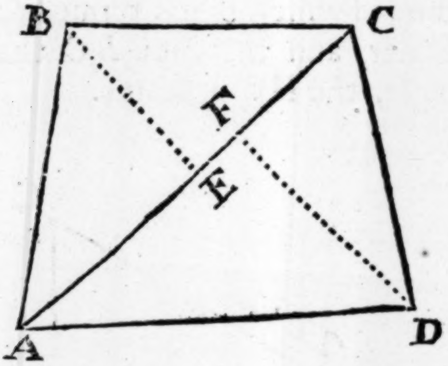


See the following Operation.

```
     56.75
     22.25
    ------
     28375
    11350
   11350
  11350
  ---------
2)1262.6875(631.3437.5 Feet.
```

Propoſition 10,

To find the Content of a *Trapezium.*



Let *A, B, C, D.* be a *Trapezium* given to find th Content.

Admit the Diagonal-line *A C* to be 9 . 5

The Perpendicular-line *AE* to be 3 . 45 } ad
The other Perpendicular *FD.* 4 . 25 }

The Sum of the Perpendicular Lines are 7 . 70

Their half Sum 3 . 85

Which ſaid 3 . 85 being to be multiplied by th Diagonal Line *A C.* 9 . 5. *Facit* 36 . 575 is the f Content of the *Trapezium* required in Feet.

3.85 } multiply
9.5 }

1925
3465

36.575 Product.

Propoſition 11.

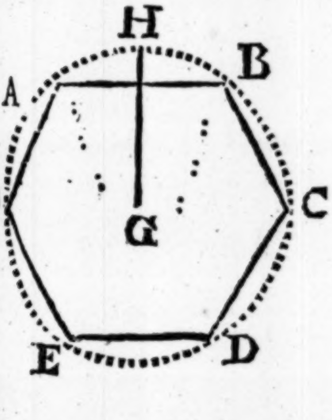
To find the Content of any regular Polygon.

DEFINITION.

A regular *Polygon* is a plain Figure conſiſting of five equal Sides, and is termed a *Pentagone*; if a Figure have 6 equal Sides, 'tis named a *Hexagon*, or *Polygon* of ſix equal Sides, if 7 a *Polygon* of ſeven equal Sides, if eight an *Octagon* of eight equal Sides!

And to meaſure any one of theſe regular *Polygons* do thus: Draw a Line from the Center of the Figure, to the middle of any one of the Sides, and multiply that Line into half the Sum of the Sides, and the Product is the Content of that *Polygon.*

Let there be given the *Hexagon ABCDEF*, having he Length of each Side 30, then will the length of he Perpendicular *G. H.* be 26 *fere*, now there being



30
6
2)180(90
0

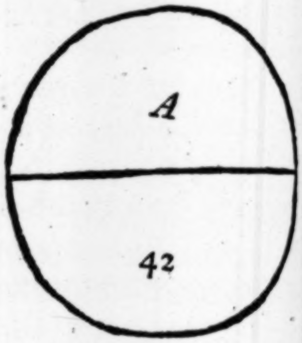
90
26
540
180
2340

all 6 Sides, each of them in length 30, therefore multiplied by 6 is 180, the half of which is 90, hich being multiplied by 26 the Product will be 340, which is the Content of the given *Hexagon.*

Propoſition 12.

To find the Length of the Circumference of a Circle, the Diameter being known.

Let *A.* be a Circle whoſe Diameter is 42, what is the Length of the Circumference ?



42
22

84
84

7)924(132

0

Multiply always the Diameter by 22, and divid the Product by 7 your Quotient is your Anſwer.

Anſwer, 132.

Propoſition 13.

The Circumference being given, to find the Di meter, as in the former Circle, the Circumſerence 42, and the Diameter required.

Multiply the Circumference always by 7, and d vide the Product by 42, and the Quotient is t Diameter.

Circumference 132
7

22)924(42 the Diameter required.
88..

44
44

0

Propoſition 14.

The Diameter of a Circle being given, to find the *Area* or Content thereof.

14)19404(1386 for Diameter, the 42
14...   Content of the Cir- 42
cle required.

54   84 } multiply
42   168 }

120   1764
112   11

84   1764 } multiply
84   1764 }

0   19404

Multiply the Diameter by its ſelf; again, multiply by 11, and divide by 14, and your Deſire is found.

N. B. As for *Solid-Meaſure*, as Pyramids, Cones, and others, they ſhall be performed after the *Square* and *Cube-Roots* are learn'd.

CHAP. XXV.

The Extraction of the Square-Root.

1. THUS much for *Arithmetick* either i Integers, or Fractions both Vulga and Decimal, proceed we now to th Extraction of Roots, *viz.* of the Squar and Cube Roots.

2. The Extraction of the Square-Root, is tha by which having a Number given, we find out ano ther Number, which being multiplied by it ſelf, pro duceth the Number given.

3. Square Numbers are either ſingle or compound

4, All the ſingle Square Numbers, together wit their reſpective Roots, are expreſſed in the Tabl here ſet down, *viz.*

Squares	1	4	9	16	25	36	49	64	8
Roots	1	2	3	4	5	6	7	8	9

When a Number is given that exceeds not 10 and yet is none of the Square Numbers mentioned this Table, for his Root: You are then to take th Root of the Square Number, that being leſs y comes neareſt to it.

5. A Compound-Square Number is that which being produced by a Number, (that conſiſts of more Places than one) multiplied by itſelf is never leſs than 100 ; ſo 576 is a Compound-Square Number, produced by the Multiplication of 24 multiplied into its ſelf.

6. To prepare any Square-Number given for Extraction, put a Point over the firſt Place thereof on the Right-hand (being the Place of Units then proceed towards the Left-hand, paſs over the ſecond Place, and put another Point over the third Place, alſo paſſing over the fifth and ſo forward, in ſuch a Method, that between every two Points, which are next one to the other, one Place may be intermitted.

24
24
———
96
48
———
576

As for Example. *To know the Root of*

)$\dot{5}7\dot{6}$(24
4
———
44)176
176
———
0
———

Again, $3\dot{3}6\dot{4}$(58 the Root.
25
———
108) 864
864
———
0
———

So that the Square-Root of 576 is 24.
And the Square-Root of 3364 is 58.

So if the Square-Root of 576 be required, the firſt Point is to be placed over 6, and the ſecond 5 as you ſee, and as many Points as are in this Manner placed, ſo many Figures the Root will conſiſt of.

$\dot{5}7\dot{6}$

7. Having thus prepared your Number, you ma
ſee it divided by the Points into ſeveral Squares; ſ
in the laſt Example 5 is the firſt Square, and 76 th
ſecond.

8. Having drawn a Quotient, find the Root o
the firſt Square, and write it down in the Quotient
ſo I find that 2 to be the Root of 5. I writ
2 in the Quotient, and ſo the work wi
ſtand thus.

576(2
•

9. Subſcribe the Square of the Figure ſ
written in the Quotient, under the fir
Square of the Number given, as you ſe
in the Margin.

576(2
•
4

10. Then ſubtract the Square of the Fi
gure in the Quotient out of the firſt Squar
and place the Remainder orderly underneat
the Line, ſo the Square of 2 which is
being ſubtracted from 5, the Remaind
is 1, as you may ſee in the Margin.

• •
576(2
4
——
1

11. To the ſaid Remainder 1, bri
down the next Square 76, being plac
next to the Remainder 1, there will b
found this Number 176, which may b
called the *Reſolvend*.

• •
576(2
4
——
176

12. Double the Root being the Nu
ber placed in the Quotient, and place th
ſaid Double on the Left-hand of your R
ſolvend like a Diviſor, ſo the double of
is 4; ſo that the Work will ſtand as y
ſee in the Margin.

• •
576(2
4
——
4)176

13. Let the whole *Reſolven*
except the firſt Place there
on the Right-hand, be alwa
eſteemed as a Dividend, th
asking how oft the Diviſor
is contained in the Divide

• •
44)576(24
4
——
44)176 *Reſolvend.*

, the Anſwer is 4, wherefore I write 4 in the Quo-
nt, and alſo after the Diviſor 4, as you ſee in the
argin. So 44 multiplied by 4 the Product is 176,
Figures of the Square Number placed above it,
Remainder is 0 : And thus the whole work being
iſhed, the Square-Root of 576, the Number pro-
unded is found to be 24

```
     .  .
     576(24
     4
     ———
   44)176
      176
      ———
        0
      ———
```

N. B. In the Extraction of the Square-Root
u muſt heedfully take Notice; firſt that if the
oduct before mentioned is greater than the *Re-*
vend placed above it, the Work is falſe, and then
u muſt Reform it by placing a leſſer Figure in the
uotient, as you do in ordinary Diviſion.

Secondly, For every one of the particular Squares,
iſtinguiſhed by Points) except the firſt Square on
e Left-hand, a new *Reſolvend* is to be ſet apart,
bringing down to the Remainder the other next
rticular Square; and as often as a new *Reſolvend*
ſet apart, ſo often a new Diviſor is to be found,
doubling all the Root in the Quotient, let them
nſiſt of never ſo many Figures.

Thirdly, for the better finding out of the firſt
gure in the Root, you are to take Notice, that it
but once uſed in the Extraction of the Root: But
e Work of the ſecond or laſt Rule is to be repeat-
, for the finding of every Place in the Root, ex-
pt the firſt.

The well-minding, and duly practiſing theſe th Notes, will exceedingly help you in the Practice the working the Square-Root; as in the followi Examples will be ſeen.

EXAMPLE. 2.

Let it be required to extract the Square Root

```
  .  .  .  .
  33016516(5746
  25
  ——
107)801 Reſolvend
    749
    ———
1144) 5265
      4576
      ————
11486) 68916 Reſolvend.
       68916
       —————
           0
```

EXAMPLE 3.

Extract the Square Root of 8328996.

```
    .  .  .  .
    8328996(2886
    4
    —
 48)432
    384
    ———
568) 4889
     4544
     ————
5766) 34596
      34596
      —————
          0
```

EXAMPLE 4.

Extract the Square-Root of 43623.

```
  . . .
  43623(208. 349/417
  4
  ---------
408)03623
    3264
    ----
     359
    ----
```

As for the Fraction annexed 359 is the Numera-
r thereof, and 417 the Denominator; the Rea-
n is thus, for as 208 the Root to be doubled is 416,
hereunto if you add an Unit (according to this
ule) the Sum is 417, and therefore the Number
ught for in this Demand is 208. $\frac{359}{417}$, as you may
e in the Example itſelf.

But for that you find, that the Root 208 to be leſs
an 209, yet how much it is greater than the ſaid
8, no Rules of Art hitherto known could exactly
ſcover, although we may proceed infinitely near,
in the next Rule ſhall be made manifeſt.

As when the Work is finiſhed there happens to be
Remainder of 359, by annexing a competent Num-
r of Cyphers to the given Number 43623, and
ork in the ſame Manner, as if there were ſignifi-
nt Figures in an Integer. See the Work.

```
      . . . . . . .
      43623.000000(208.861
      4              The Root.
  408)03623
       3264
      ------
 4168) 35900
       33344
       -------
41766) 255600
       250596
       --------
417721) 500400
        417721
        --------
         82679
        --------
```

208.$\frac{861}{100}$

So that according to the Rules aforegoing, y ſhall find the Root thereof to be 208.861, which equivalent to 208.$\frac{359}{417}$, for the whole Parts are t ſame in both the Roots; and as for the broken Par $\frac{359}{417}$ and $\frac{861}{1000}$ or .861 have the ſame Value, as is a parent by the Example premiſed.

Again, if 10 were propounded to be extracted, muſt prepare it thus.

EXAMPLE 5.

```
      .  . . . . . . :
      10.00000000000000(3.162276
      9                 ————————
     ———                 10000000
 61) 100
      61
     ————
626) 3900
     3756
     —————
6322)  14400
       12644
       ——————
93242) 175600
       126484
       ———————
632447) 4911600
        4427129
        ———————
         484471
        ———————
```

And here obſerve that in theſe Caſes, the more phers you annex to the Number given, the more and exact the Operation will prove.

The PROOF.

The Extraction of the Square-Root, is proved multiplying the Root by itſelf; for that done, Product (in ſuch Caſes when there is no Re- inder after the Extraction is finiſhed) will be equal

qual to the Number, whoſe Square-Root was r
quired: So in the firſt Example 24 being multipli
by itſelf, produceth 576 the Number propounde
But when after Extraction is finiſhed, there happe
eth to be a Remainder, which muſt be taken in,
in the Manner of the proving *Diviſion*, thus as
the fourth Example.

```
    208.861
    208
    ———
    1664
   4160
   ————
   43264
     359 Remainder added.
   —————
   43623
```

To extract the Square-Root of a Fraction.

It is found in this Manner, *viz.* extract the Ro
of the Numerator, which ſhall be a new Numerato
alſo the Root of the Denominator is to be taken
a new Denominator; ſo the new Fraction, ſhall
the Square-Root of the Fraction firſt propounde
Thus the Square-Root of $\frac{9}{16}$ is $\frac{3}{4}$ alſo the Squa
Root of $\frac{8}{16}$ is $\frac{1}{2}$ and of $\frac{1}{4}$ is $\frac{1}{2}$.

Again, extract the Square-Root of $\frac{8}{18}$ being a
breviated is $\frac{4}{9}$, the Root of this may be extracte
and is found to be $\frac{2}{3}$ equivalent unto $\frac{8}{18}$ each Term
incommenſurable; but the ſaid $\frac{8}{18}$ being reduced
its loweſt Terms $\frac{4}{9}$, there will be found in each Te
a commenſurable Root, *viz.* the Square-Root of
is 2, and the Square-Root of 9 is 3, ſo is $\frac{2}{3}$ equiv
lent unto $\frac{8}{18}$.

Wh

When either the Numerator or Denominator of a Fraction hath not a perfect Square-Root, ſuch Root may be expreſſed by prefixing this Character before it, *viz.* √, or √q before the Fraction given; ſo the Square-Root of $\frac{13}{16}$ is ſignified thus √$\frac{13}{16}$ becauſe the Root of $\frac{13}{16}$. cannot be expreſſed by any true or rational Number whatſoever, yet it may be found very near, as in the next Rule.

To extract a Square-Root near of a mixt Number.

The Square-Root of a mixt Number commenſu-able to its Root, muſt firſt be reduced into an im-roper Fraction; ſo the Square-Root 34. $\frac{33}{64}$ will be ound 5. $\frac{7}{8}$, *viz.* 34. $\frac{33}{64}$ being reduced into the impro-er Fraction $\frac{2209}{64}$, the Square-Root of the Numera-or 2209 will be 47 for a new Numerator; alſo the quare-Root of the Denominator 64 is 8 for a new Denominator, ſo it is found $\frac{47}{8}$, which ſaid impro-er Fraction is 5. $\frac{7}{8}$ the Square ſought.

Here always Note, That you bring the fractional art of the mixt Number into its leaſt Terms, bere any Extraction can be made.

Thus much for the Extraction of the Square-Root; roceed we now to the Extraction of the Cube-oot.

THE Extraction of the Cube-Root is that, by which having a Number given, we find ano-er Number, which being firſt multiplied by itſelf, d then by the Product produceth the Number given.

In the Extraction of the Cube-Root, the Num-rs propounded are always conceived to be a Cube-umber, that is, a certain Number of little Cubes, comprehended within one entire great Cube, and the Root or Number required is the Side of the Square, which conſtitutes that great Cube.

Definition of a Cube.

What a Cube is may be well conceived by a Dye, which indeed is a little Cube itſelf; wherefore if you place four Dice in a ſquare Form, that is laying two, and two in a Rank, you ſhall have a Square containing four Dice, upon which if you yet erect ſuch another Square of Dice, you ſhall have a great entire Cube comprehending 5 times 25, that is, 125 little Cubes. And in this Caſe 125 is the Cube Number propounded, and 5 the Root or Number required.

5
5
——
125
——

A Cube Number is either Single or Compound; the ſingle Cube-Numbers together with their reſpective Roots are expreſſed in the Table following.

Cubes	1	8	27	64	125	216	343	512	729
Squares	1	4	9	16	25	36	49	64	81
Roots.	1	2	3	4	5	6	7	8	9

Here in the uppermoſt Rank are placed the ſingl Cube Numbers of the particular Figures 1 2 3 4 5 7 8 9, in the next the Squares of thoſe Figures, and i the loweſt Rank the Figures themſelves, being the reſpective Roots of the Cubes and Squares in the uppermoſt Ranks; and therefore the Cube-root of 1 being demanded, the Anſwer is 5, and the Cube root of 512 being required, the Table will give y 8, and ſo of the reſt.

A compound Cube Number is that, which being roduced by itſelf, is never leſs than 1000, ſo 405224 s a compound Cube Number, being produced by hus :

```
           74          5476
           44            74
         ————          ————
          296         21904
          518         38332
         ————        ——————
The Square 5476      405224 Cube-Number.
         ————        ——————
```

To prepare a Cube Number for Extraction, put Point over the firſt Place thereof, towards the ight-hand, (to wit the Place of Units) then paſ- ng over the ſecond, and third Places, put another oint over the fourth, and paſſing over the fifth and xth Places, put another Point over the ſeventh, and that Order (two Places being intermitted) place many Points as the Number given will admit; ſo 5224 being given, place the Points thus :

$$40\dot{5}22\dot{4}$$

Having thus prepared your Number, you may ſee diſtributed by the Points into ſeveral Cubes; ſo in is Example 405 is the firſt Cube, and 224 the cond.

Having drawn a crooked Line on the Right-hand the Number propounded to ſignify a Quotient, d the Cube-root of the firſt Cube, and place it in Quotient, ſo I finding 7 to be the correſpondent ot of 405, I write 7 in the Quotient thus :

$$40\dot{5}22\dot{4}(7$$

Then ſubſcribe the Cube of the Root placed in the Quotient thus .

40$\dot{5}$22$\dot{4}$(4
343

62

Draw a Line and ſubtract that Cube Number and there remains 62.

To the ſaid Remainder (*viz.* 62) bring dow
the next Cube of the Number propounded, *viz.* 22
being placed after the Remainder 62, there will b
found this Number 62224, which may be calle
the *Reſolvend.*

Thus $\dot{4}$0522$\dot{4}$(7
343

62224 *Reſolvend.*

Having drawn a Line underneath the *Reſolven*
ſquare the Root in the Quotient, that is, multip
it by it ſelf, and ſubſcribe the triple of the ſa
Square or Product, under the *Reſolvend* in ſuch Ma
ner, that the firſt Place (to wit the Place of Uni
of the ſaid triple Square 147 may ſta
directly under the third Place in the *Re*
vend; ſo the Square of the Root 7 is
the triple whereof is 147, which I ſubſcri
under the *Reſolvend* in ſuch Manner, t
the Figure 7 which is in the firſt Plac
the triple Product, 147 may ſtand under
you ſee.

7
7

49
3

147

7
3
—
21

Triple the Root or Number in the Quotient, viz. 7, which is 21, and ſubſcribe this triple Number under the ſecond in the *Reſolvend.*

Then ſquare the ſaid Root, and then triple the aid Square of the Root in its right Place, as you may ee by the Work. Thus

```
 .  .
405224(7
343
————————
 62224 Reſolvend.
————————
    21 Triple Root                  }
   147 Triple Square of the Root.   }add
————————
  1491 Diviſor.
————————
```

Let the whole *Reſolvend*, except the firſt Place hereof towards the Right-hand, be eſteemed as a ividend, then demanding how often the firſt Fi-ure (towards the Left-hand) of the Diviſor is con-ained in the Dividend, write the Anſwer in the uotient, which will be 4.

Having drawn another Line under the Work, ultiply the Square before ſubſcribed, by the Fi-ure laſt placed in the Quotient, and ſubſcribe this roduct under the ſaid triple Square, ſo 147 being ultiplied by 4, the Product is 588, which I ſub-ribe thus as you ſee.

```
 .  .
405224)74
```

405224(74
343

62224 *Reſolvend.*

21 Triple Root.
147 Triple Square of the Root.

1491 Diviſor.

588 Triple Square of the Root multiplied
by 4.

4
4

16
21

16
32

336

Then you muſt next multiply the Figur laſt placed in the Quotient, firſt by it ſelf which is 16, and then the Product of 1 by 21 the triple Root, ſo that 16 bein multiplied by 21, the content is 336.

Laſtly by ſquaring the laſt Figure which makes 16, and multiplying again b 4, makes the Cube of 4, 64.

4
4

16
4

64

1491 Diviſor.

588 Triple Square of the Root.
336 Square of 4 multiplied by 2
64 Cube of 4

62224 *Subtrahend.*

Which ſaid *Subtrahend* being ſubtracted from t *Reſolvend* 62224 the Remainder is 0, thus the wh Operation being finiſhed the Cube-root of 405224 found to be 74.

The whole Operation.

405224(74
343

1491) 62224 *Reſolvend.*

21 Triple Root } add, *facit*
147 Triple Square of the Root. } Diviſor.

1491 Diviſor.

588 Triple Square of 147 by 4.
336 Square of 4 multiplied by 21.
64 Cube of 4.

62224 *Subtrahend.*

(0)

Explanation 343 is the Root of 7.

7	147	4
3	4	4
—	—	—
21	588	16
—		4
		—
	4	
7	4	64
7	—	—
—		
	16	
49	21	
3	—	
—		
	16	
147	32	
	—	
	336	

Note, the Learner ought to obſerve theſe three Things from the Rules before delivered, concerning the Extraction of the Cube-root.

NOTE the firſt.

When the Sum of the three laſt Numbers beforementioned are greater than the *Reſolvend*, the Work is erroneous, which may be reformed by placing a leſſer Figure in the Quotient.

NOTE the ſecond.

For every one of the particular Cubes (diſtingiſhed by Points) except the firſt Cube on the Left-hand, a *Reſolvend* is to be ſet apart, by bringing them down to the Remainder of the next Cube. And as often as a *Reſolvend* is ſet apart, ſo often is a new Diviſor to be found, by adding the triple of all the Root in the Quotient, to the triple of the Square of ſuch Root, after they are orderly placed.

NOTE the third.

For the finding of the firſt Figure in the Root, it is but once uſed in the Extraction of the Root of any Number whatſoever; but the Work of all the preceding Rules beforementioned, is to be uſed for the finding of every Place in the Root,, except the firſt.

The Practice of theſe three Notes, will be demonſtrated in the following Examples.

Let it be required to extract the Cube-root of

4862715(365
27

279)21627

9 The triple Root.
27 The triple Square of the Root.

279 Diviſor.

216 the Cube of 6
324 the Square of 6 in the triple Root.
162 the triple Square of the Root into 6.

19656 the *Subtrahend.*

988)1971125 *Reſolvend.*

108 the triple Root of 36.
3888 the triple Square of the Root 36.

38988 Diviſor.

125 the Cube of 5.
2700 the Square of 5 in the triple Root.
19440 the triple Square of the Root in 5.

1971125 the *Subtrahend.*

0

5	108	3888
5	25	5
25	540	19440
5	216	
125	2700	

EXAMPLE 3.

Let it be demanded to extract the Cube-root

8302348(202+

8

126)0302 *Reſolvend.*

12

06

126 Diviſor.

12060)302348 *Reſolvend.*

1200

60

12060 Diviſor.

2400

240

08

242408 *Subtrahend.*

59940

Now if 242408 the *Subtrahend* is ſubtracted fr the *Reſolvend* 302348, there remains 59940.

I conclude, that the Cube-root ſought is grea than the ſaid 202, but leſs than 203; yet how mu it is greater than 202, no Rules of Art hithe known will exactly diſcover, although we may p ceed infinitely near, as by the next Rule will be ma manifeſt.

dd Ternaries of Cyphers, to wit 000, *or* 000000, *or* 000000000, *then work as in the preceeding Rules.*

.	.	.		
302	348	000		
302				*Reſolvend.*
2				
06				
26				*Diviſor.*
302	348			*Reſolvend.*
120	0			
	60			*Diviſor.*
120	60			
240	0			
2	40			
	08			
242	408			*Subtrahend.*
59	940	000		*Reſolvend,*
12	241	2		
	6	06		
12	247	26		*Diviſor.*
48	964	8		
	96	96		
		64		
49	061	824		*Subtrahend.*
10	878	176	000	*Reſolvend.*
1	228	972	8	
		60	72	
1	229	033	52	*Diviſor.*
9	831	782	4	
	3	886	08	
			512	
9	835	668	992	*Subtrahend.*
1	042	507	008	

So that you ſhall find the Cube ſought to be 202.48 that is $\frac{48}{100}$ and more, wherefore you may conclude, that 202.$\frac{49}{100}$ is greater than it, ſo that by annexing two Ternaries of Cyphers, to wit, *6* Cyphers to the Number propounded, you will not miſs $\frac{1}{100}$ Part of an Unit of the true Root, alſo by annexing three Ternaries of Cyphers, to wit *9* Cyphers, you will not miſs $\frac{1}{1000}$ Part of an Unit of the true Root.

To extract the Cube-root of a Fraction.

The Cube-root of a Fraction is thus found, *viz* extract the Cube-root of the Numerator, whic Root will be as a new Numerator; alſo the Cube root of the Denominator, ſhall be as a new Deno minator; ſo the Cube-root of $\frac{8}{27}$ is $\frac{2}{3}$; for the Cube root of 8 is 2 for a new Numerator, alſo the Cube root of 27 is 3 for a new Denominator: But her Note diligently, That the Fraction whoſe Cube root is required, muſt be brought into its leaſt Terms before any Extraction can be made, ſo in this Fra ction $\frac{16}{54}$ being reduced to its loweſt Terms is the Cube-root of this may be extracted, for th Cube-root of 8 is 2, alſo the Cube-root of 27 i is 390 that the Cube-root of $\frac{8}{27}$ equal, is found t be $\frac{2}{3}$.

I might here proceed to ſhew the Extraction o other Roots, as the *Biquadrate*, *Quadrato-Cube*, *Cub Cube*, and the like, of other Operations in Fractions *&c.* but by Reaſon their Operation is exceeding t dious, difficult, and cannot be naturally underſtoo without the Knowledge of that moſt excellent, b myſterious Art called *Algebra*, which hath bee moſt excellently, plainly, and learnedly ſet forth, b the moſt ingenious, learned, and able Mathematicia of this Age, Mr *John Kerſey*, my moſt honoure and worthy Maſter, to whom I owe all that I kno in Numbers.

The Proof of the Extraction of the Cube-root.

The Extraction of the Cube-root is thus proved, b multiplying the Root cubically; ſo in the firſt E ample 74· being multiplied by 74, the Square of is 5476, which being again multiplied by 74, pr duceth the Cube-root 405224, which is equal to t

gi

iven Number, therefore I conclude the Operation o be right.

But when after the Extraction is finiſhed, there appeneth to be a Remainder, ſuch Remainder muſt e added according as you work in the Proof of iviſion ; and if the Sum maketh the given Number, e Work is rightly performed.

Now followeth the Uſe of the *Square* and *Cube-oots*, in ſolving ſome Queſtions *Arithmetical* and *eometrical*.

The Uſe of the Square and Cube Roots.

Propoſition I.

o find a mean Proportional between two given Numbers.

MUltiply the given Numbers, the one by the other, and extract the Square-root of the oduct, ſo ſhall that Square-root be the mean Pro- rtional ſought.

EXAMPLE.

Let the given Numbers be 16 and 64, according your Rule multiply 16 by 64, and the Product 1024, the Square-root of which is 32, ſo that is the mean Proportional between 16 and 64.

Thus,

16⎫
64⎭multlply

64
96

1024(32 Square-Root.
9

62)124
124

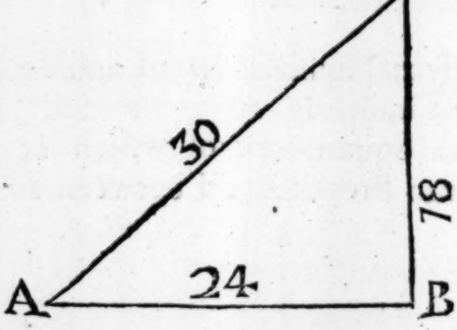
0

Propoſition 2.

Having any two of the Sides of a right angl plain Triangle given, to find the third ſide.

As for EXAMPLE.

In the Triangle *A, B, C* the Baſe *A, B.* is 24, a the Perpendicular *B, C.* is 18, now I demand t length of the Hypothenuſe ?



To Anſwer this Propoſition, you muſt firſt Square Baſe *A. B.* 24, which is 576, then Square the pendicular 18, which maketh 324; then add ſe two Sums together, and the Product is 900, the Square-root of 900 is 30, which gives the ngth of *A, C.*

This Propoſition is of great Uſe in the Menſura- ion of Heights, Diſtances and other Mathema- al Figures.

Propoſition 3.

f the three Sides of a Piece of Land, that lies in Form of a Triangle be 15 Perches, 14 Perches, 13 Perches, what is the *Area* or Number of are Perches contained in that Triangle?

nſwer, 84 Perches, or half an Acre and 4 Perches, which content is found out by this Rule, *viz.*

rom half the Sum of the three Sides of any n Triangle, ſubſtract each of the three Sides ſe- lly, and note the three Remainders; then mul- y the ſaid half Sum, and thoſe three Remainders into the other; that done, extract the Square- t of the laſt product. So ſhall ſuch Square-root he *Area*, or Content of the Triangle.

The Work.

1
6

Perches

6 The 3 Sides of the Triangle are $\left\{\begin{matrix}15\\14\\13\end{matrix}\right\}$ add

7

2 The Sum of the 3 Sides 42 *Perches*

8

6 The half of that Sum 21

The three Remainders found out by ſubtracting each Side from the half Sum } 6 7 8

The Product ariſing from the continual multiplication of the four laſt Numbers } 70

The Square-root of 7056 is the Content requir to wit 84.

```
7056(84 Perches, or ½ an Acre and 4 Perch
64
———
164)656
    656
    ———
```

Propoſition 4.

Another EXAMPLE.

The three Sides of a Triangle	120 112 90
The Sum of the three Sides	323
The half of that Sum	161
The three Remainders found out by ſubtracting each Side from the half Sum.	41 . 49 . 71 .

The Product ariſing from the continual Multi cation of the four laſt Numbers, are

23355380 1096

The Square-root of that Product is 4832.7+.

Wherefore the Content of a plain Triangle, whoſe Sides are as afore-recited 4832.7+ Perches, the Fractions of a Perch being neglected.

The Operation of the ſaid laſt Sum; for the Benefit of the Learner I here have worked it.

```
161 . 7
 41 . 2
 49 . 1
 71 . 4
```

Multiplied continually thus;

```
   161 . 7
    41 . 2
  --------
      3234
     1617
    6468
  --------
   6662.04
      49.1
  --------
    666204
  5995836
 2664816
  --------
 327106.164
       71.4
 ----------
 1308424656
 327106164
2289743148
----------
23355380.1096 The Square-Root.
```

The Square Root of that Product.

. : . . : .
23355380.1096(4832.74+
16

735
704

3153
2889

26480
19324

715610
676529

3908196
3866176

42020

Wherefore I conclude, that the Content of a plai
Triangle, whoſe three Sides are 120.5 Perches
112.*6* Perches, and *90.3* Perches are 4832.74+ Perche
which being reduced, gives 30 Acres and 32 Perches
the Fraction of a Perch being neglected.

Propoſition 1.

Of Solid Meaſure.

If the Side of a Cube be 12 Inches, how man
cubical Inches are contained in that Cube?

Anſwer 1728.

RUL

RULE.

Multiply the Length by the Breadth, and that Product by the Depth; as in this Example,

```
  12
  12
 ----
 144 Square Inches.
  12
 ----
1728 Cubical Inches.
 ----
```

In like Manner, if the Side of a Cube of Stone be 2.53 Feet, the ſolid Content of that Cube will be 16.194277 Feet.

Thus,

```
     2.53
     2.53
   ------
      759
    1265
    506
   ------
   6.4009
     2.53
  -------
   192027
  320045
 128018
---------
16.194277 Feet.
---------
```

Solid in Geometry, is the third Species of Magnitude, having three Dimenſions, Length, Breadth, and Thickneſs.

Propoſition 2:

How many ſolid Feet are contained in that Piece of Timber whoſe Length is 17 Feet ½, 23 Inches Broad, and in Depth 2 Feet 7 Inches?

Feet			*In Decimals by the Table.*
17 . ½	Length =	equal	17 . 5
0 . 23	Inches Breadth =		1 . *9166*
2 . 7	Inches Depth =		2 . 5833

Multiply continually.

1.9166
17.5

95830
134162
19166

33.54050
2.5833

10062150
10062150
26832400
16770250
6708100

86.646173650

Feet Inches Parts
Anſwer, 86 . 7 : 9 +

Propoſition 3.

There is a Stone come from *Purbeck*, that is 5 Feet 9 Inches Long, 3 Feet 11 Inches broad, and 2 Feet 8 Inches deep; I would know how many ſolid Feet are contained in this Stone?

By Decimals.

Inches
9 = .75
11 = .9166
8 = .66666

Thus,

3.9166
5.75

1958330
2741662
1958330

22.5207950
2.666

1351247700
1351247700
1351247700
450415900

60.0404394700

Feet *Inches*
Anſwer, 60 . 00 . +

By Vulgar Arithmetick.

F.	*I.*	*F.*	*I.*	*F.*	*I.*
5	9	3	11	2	8
12		12		12	
69		47		32	

69
47

483
276

3243
32

6486
9729

103776

12 *Feet* *Inch* *Pts.*
144)103776)720(60 . 00 $\frac{2}{3}$ 8
1008 72
297 00 .
288
96

Propoſition 4.

A Vault dug 9 Feet deep, 4 Feet 6 Inches long, and three Feet 9 Inches broad, how many ſolid Yards?

```
          4.5
            9
        ------
         40.5
          3.75
        ------
         2025
        2835
       1215
       -------
       151.875 Feet.
```

```
                                  Yards Feet Inches.
27)151.875(5.621   Anſwer 5 . 16 . 10+
   135
   ---
    168
    162
    ---
      67
      54
      --
      35
      27
      --
       8
```

Propoſition 5.

How many Yards of digging will there be in a Cellar that is 25 Feet 4 Inches long, 15 Feet 8 Inches broad, and 7 Feet and an half deep?

```
        Decimally.
        25.33 Length,                 25.33
        15.66 Breadth,                15.66
          7.5 Depth.               ---------
       ------------                   15198
                                     15198
          Yds  Feet                 12665
  27)2975(110 : 5                   2533
    27                           -----------
   ----                            396.6678
     27                                 7.5
     27                          -----------
    ----                           19833390
     05                           27766746
    ----                         -----------
                                  2975.00850
```

Propoſition 6.

If the Breadth of a ſquare Piece of Timber, ha-ing equal ſquare Baſes be 1.55 Foot, how far ought ne to Meaſure along the Length of that Piece of imber to make a Foot ſolid.

Anſwer, 416 Parts of a Foot, or 5 Inches very near.

Which Decimal is thus found, *viz.* multiply 1.55 y 1.55, the Product is 2.4025, then dividing 1 (to it, 1 ſolid Foot by the Baſe 2.4025, the Quotient ill be .416+or 5 Inches; *fere.*

Thus,

2.4025)1.000000(.416 = 5 Inches by *Decimal Tables*
96100

39000
24025

149750
144150

5600

Propoſition 7.

If a ſtrait ſquared Piece of Timber be termi nated by unequal Baſes, whereof one contai 1.92 ſuperficial Feet, the other .85 Feet, and th Length of that Piece of Timber be 17.4 Feet, wha is the ſolid Content, or how many cubical Feet a contained in that Piece of Timber?

This Queſtion is out of Mr. *Oughtred's Rules, Pr blem* 21. *Chap.* 19. of his *Clavis Mathematica.*

The RULE.

Multiply the greater Baſe by the leſs, and extra the Square-root of that Product. Then multip the Sum of the two Baſes, and that Square will $\frac{1}{3}$. Part of the Length of the Solid propounde ſo ſhall the laſt Product be the ſolid Content r quired.

The Operation.

he greater Baſe	1 . 92
he leſſer Baſe	0 . 85
he Product of the Multiplication of thoſe two Baſes	1 . 6320
he Square-root of that Product	1 . 2774
he Sum of that Square-root and the two Baſes	4 : 0474
of the Length is	5 . 8
he Product of the Multiplication of the two laſt Numbers is the Solid Content required, *viz.*	23. 474 +

quare-root

$$\left.\begin{array}{r}1.2774\\1.92\\0.85\end{array}\right\}\text{added}$$

4.0474 the Sum

Length

3)17.4(5.8 : ⅓ of the Length.
15
24
24
0

1.92
.85
960
1536
1.6320 Product

4.0474 the Sum.
5.8
323792
202370
23.47492

The ſolid Content for Anſwer.

Propoſition

Propoſition 8.

To meaſure a Pyramid.

A Pyramid is a ſolid Figure, whoſe Baſe is a *Pol* *gon*, and whoſe Sides are plain Triangles, their ſever Tops meeting together in one Point at the Top.

Now if the ſuperficial Content of the Baſe of Pyramid be 5.756 Feet, and the Height thereof 14.2 (which ſaid Height is the Length of the Perpendic lar Line, that falleth from the Top of the Pyrami to the Baſe) what is the ſolid Content of th Pyramid ?

RULE.

The *Area* of the Baſe of the Pyramid be mult plied by $\frac{1}{3}$ of the Height thereof, the Product ſh be the ſolid Content of the Pyramid, Therefore $\frac{1}{3}$ of 14.25 is equal to 4.75, and 5.756 the Baſe be multiplied by 4.75 = 27.341 Feet, the Solidity of the Pyramid required.

```
3)14.25(4
  12
  ——
   22
   21
   ——
    15
    15
    ——
     0
    ——
```

```
     5.756
      4.75
    ——————
     28780
    40292
   23024
   ———————
   27.34100 Solid Feet.
   ————————
```

Propoſition 9.

To meaſure a Cylinder.

A Cylinder is a Solid, which may be well repre-
ed by a Stone-Roll; now if the Circumference
Cylinder be 4.57 Feet, and the Length 3 25 Feet,
t is the ſolid Content of that Cylinder?

RULE.

irſt by the Help of the given Circumference
, find out the ſuperficial Content of that Circle,

s 1 is to .079578 . . . . . 20.8849

```
   .079578
   20.8849
   -------
    716202
   318312
  636604
 636604
1591560
-------
1.6619+
-------
```

```
For 4.57}
    4.57}multiplied
   -----
    3199
   2285
  1828
  -------
  20.8849
  -------
```

o find out the ſuperficial Content of a Circum-
ce, the Proportion is as

1 is to .079578:

Propoſition 10.

To meaſure a Globe.

A Globe is a perfect round Body contained und one Plain; in the middle of the Globe, there is Point called the Center, from whence all ſtr Lines drawn to the Out-ſide, are of equal leng and called Semidiameters, the Double of any o of which is equal to the Diameter of the Globe.

Now if the Diameter of a Globe of Stone 1.75 Feet, how many Feet ſolid are contained that Globe?

Anſwer, 2.807 Feet, for as 21 is in Prop tion to 11, or as 1 is to .5238, is the Cube of the Diameter, to ſolid Content of the Globe.

Therefore multiplying always the Cube of the D meter by the Decimal .5238, the Product ſhall the ſolid required.

So the Diameter 1.75 being firſt multiplied by ſelf, the Product will be 3.0625, which multiplie gain by the ſaid 1.75, gives for the Product 5.3593 to wit the Cube of the Diameter; which being m tiplied by .5238, the Product thence ariſing be 2.807 +, which is the Solidity of the Gl propounded.

The Operation.

$$\begin{array}{rl}
1.75 & \\
1.75 & \\
\hline
875 & \\
1225 & \\
175 & \\
\hline
3.0625 & \\
1.75 & \\
\hline
153125 & \\
214375 & \\
30625 & \\
\hline
5.359375 & \text{Cube.} \\
.5238 & \\
\hline
42875000 & \\
16078125 & \\
10718750 & \\
26796875 & \\
\hline
2.8072406250 & \text{the Solidity of the Globe.} \\
\hline
\end{array}$$

CHAP.

CHAP. XXVI.

Simple-Intereſt.

1. I Shall now proceed to *Intereſt of M* wherein the greateſt and moſt u Operations, are done by *Deci* *Arithmetick.*

2. *Intereſt* is either *Simple* or *Compound.*

3. *Simple-Intereſt* is, when a Sum of Money is and the Intereſt thereof, when due, is not paid, kept in the Borrowers Hands, and yet becomes n Part of the Principal, then it is called *Simple-Int* So if 100 *l.* be lent for two Years, the Simple-I reſt thereof after the Rate of five Pounds for Year, will be ten Pounds, *viz.* five Pounds due the firſt Year's End, and five due at the ſecond Y End.

4. *Compound-Intereſt* is that, when a Sum of ney is lent, and the Intereſt when due is not but kept in the Borrower's Hands, and by Means becomes a Part of the Principal, then it is led *Compound-Intereſt.*

As for Inſtance, If *A.* lend to *B.* an 100 *l.* at Rate of 5 *l.* *per Cent. per Annum* for three Years, Compound Intereſt thereof is to be computed

Rate of five Pounds for 100 *l.* there will ariſe des the Simple-Intereſt of the Principal for three rs, the Intereſt of five Pounds, (due at the firſt r's End) for two Years, and the Intereſt of 5 *l.* at the ſecond Year's End) for one Year following.

his Analogy being agreed upon, the Manner of puting Simple-Intereſt for any Principal Money , or forborn any Time of Years propounded, will he Work of the next following Pages.

hat is the Intereſt of 175 *l.* 18 *s.* 11 *d.* for one r, at the Rate of 5 *l.* for 100 *l?*

```
     l.    s.    d.
    175 . 18 . 11  at 5 l. per Cent.
                5
  ___________________
    8|79 . 14 . 7
     |20
  ___________
   15|94
     |12
  ________
    1|15
  ________
```

l. *s.* *d.*
Anſwer, 8 15 1

his Queſtion is wrought as you have learned e.

the Intereſt of 100 *l.* Principal for one whole be known, the Simple-Intereſt of any other ipal, for any Number of Days more or leſs 365, may be found out by the following Rule, Multiply thoſe three Numbers according to Rule of continual Multiplication, to wit, the gi Intereſt of 100 *l.* for a Year, the Principal whoſe tereſt is required, and the Number of Days p ſcribed, reſerving this laſt Product for a Divide Then multiply 365 by 100, and let that Product your Diviſor, ſo ſhall the Quotient be the Intereſt Gain ſought.

Note, here, that the two Principals, *viz.* 10 and the other propounded muſt be of one Deno nation. Alſo the Intereſt required, muſt be of ſame Denomination with the given Intereſt of 10

For an Example of this Rule, Let it be requi to find out the Intereſt of 400 *l.* for 7 Days, at Rate of 6 *l.* *per* 100 *l.*

The Operation.

400. Principal.
6. Intereſt.

2400

7 Days.

16800 Dividend.

365 by 100
100

36500 Diviſor.

```
                                s.  d.
36500)168000000(.4602=9 . 2 . 2/4
      146000....
      ---------
        220000
        229000
        -------
        100002
         73000
        -------
         27000
        -------
```

s will appear by the brief Way of valuing a De-
al Fraction.

The Reaſon of the abovementioned Rule, will
manifeſt, by ſolving the ſame Queſtion by two
e *Rules of Three*, See Page 351.

A TABLE *for the ready finding the Decima Parts of a Year, equal to any Number* *Days.*

Days-Decimal Parts.	Days- Decimal Parts.	Days— Decimal Parts.
1=0.002740	10=0.027397	100=0.273973
2=0.005479	20=0.054794	200=0.547945
3=0.008219	30=0.082192	300=0.821918
4=0.010959	40=0.109589	365=1.000000
5=0.013699	50=0.136986	
6=0.016438	60=0.164383	
7=0.019178	70=0.191781	¼ *of a year*=0.25
8=0.021918	80=0.219178	½ *a year* =0.5
9=0.024657	90=0.246575	¾ *of a year*=0.7

The Uſe of this Table.

Suppoſe it were required to find the Deci Parts of a Year equal unto 135 Days.

Thus,

$$\left.\begin{array}{rl} 100 \text{ Days} = & 0.273973 \\ 30 \text{ Days} = & 0.082192 \\ 5 \text{ Days} = & 0.013699 \end{array}\right\} \text{add}$$

Hence 135 Days = 0.369864 Decimal.

```
     l.      l.           l.
If 100  Gain 6  what will 400
                            6
                         ----
                         2400
                         ----
                         l.  s.  d.
           1|00)24|00(24 : 0 : 0

        Days        l:          Days
Than if 365———————24———————what 7
                  20
                 ----
                 480
                  12
                ----
                5760
                   4
               -----
               23040
                   7
               -----4   12  s.  d.
         365)161280(441(110(9 : 2 ¼.
             1460           108
             ----          1----
             1528             2
             1460
             ----
              680
              365
              ---
              315
```

What is the Intereſt of 1000 *l.* for 131 Days a the Rate of 6 *l. per Cent. per Annum?*

1000
6
6000
131
6000
18000
6000

365 X 100
36500

36500)786000.000(21.534
9000.

21.534+is 21 *l.* 10 *s.* 8 *d.* ¼ for Anſwer.

Suppoſe it is required to find what Sum 78o 15 *s.* will amount to in 3 Years and 179 Days, 5 *l.* 10 *s. per Cent.*

By the Table thus,

$$\left.\begin{array}{rll} 3 \text{ Years} & = & 3.000000 \\ 100 \text{ Days} & = & 0.273973 \\ 70 & = & 0.191781 \\ 9 & = & 0{:}024657 \end{array}\right\} \text{ad}$$

Hence 3 Years and 179 Days is = 3.490411 Ti

Principal is 780.75 } multiply
Time 3.4904 }

312300
7026750
312300
234225

2725.129800 } multiply by the Inter
0.055 } or Rate.

13625649000
13625649000

149.8821 +

	l.	*s.*	*d.*	
That is	149 :	17 :	7	the Intereſt.
To which add	780 :	15 :	0	the Principal.
	930 :	12 :	7	the Amount required.

e Way of ſumming up Annuities in Arrear, with Allowances of Simple-Intereſt.

If an Annuity or yearly Rent of 134 *l.* 10 *s.* 6 *d.* all forborn till the End of four Years, what will it n amount unto at the Rate of *6 l. per Cent. per Ann.* each Year's Rent, from the Time on which was due, until the End of the ſaid Term of four ars?

Anſwer, 586 *l.* : 10 *s.* : 6 *d.* + $\frac{26}{100}$.

To Anſwer this Queſtion, look for four Years in the Column of Years, and the Number againſt it is 4.36. which is the Amount of 1 *l.* Annuity for four Years; therefore having turned the Decimal of 10*s.* 6 *d.* in the given Annuity into a Decimal, which is .525; I ſay by the *Rule of Three* thus:

```
   l.                 l.              l.
If 1 ———————————— 4.36 ———————— what 134.525
                                        4.36
                                     ————————
                                      807150
                                     403575
                                    538100
                                    —————————
                                    586.52900
                                    —————————
```

Thus by the Operation, I find the Anſwer to be 586*l.* 10*s.* 6 *d.* by the valuing of a Decimal before taught. And it is plain, that in ſolving Queſtions by this Table, (the firſt Number in the *Rule of Three* being Unit) if you multiply the given Annuity by the Tabular Number, then the Product will be the Anſwer.

TABLE the Second.

Which ſheweth in Pounds and Decimal Parts of a Pound, the Amount of one Pound Annuity, being forborn to the End of any Number of Years under 31 Simple Intereſt, being computed after the Rate of 6 per Cent. per Annum.

1.00
2.06
3.18
4.36
5.60
6.90
8.26
9.68
11.16
12.70

11	14.30
12	15.96
13	17.68
14	19.46
15	21.30
16	23.20
17	25.16
18	27.18
19	29.26
20	31.40
21	33.60
22	35.86
23	38.18
24	40.56
25	43.00
26	45.50
27	48.06
28	50.68
29	53.36
30	56.10

What is the Amount of an Annuity of 250 *l* 10 *s:* ng forborn to the End of 12 Years, allowing ple-Intereſt after the Rate of 6 *l. per Cent. per* n.

Anſwer, 399 *l.* 15 *s,* 11 *d.* ¾.

Thus,

The given Annuity 250.5
e Tabular Number for 15.96
2 Years.

15030
22545
12525
2505

	l.	*s.*	*d.*
399.7980 =	399	15	11 ¾.

Examp. 3. What is the Amount of an Annuit of 80 *l.* a Year being forborn 7 Years at the Ra of 6 *l. per Cent. per Annum.* Anſwer, 660 *l.* 16

The given Annuity 80 *l.*
Number of 7 Years 8.26

480
160
640

660|80

Anſwer, 660 *l.* 16 *s.* by the valuing of the Decimals.

TABLE the Third.

Which ſheweth the worth of a Pound Annuity to continue any Number of Years under 31 *Years Simple-Intereſt, being computed at* 6 per Cent. per Annum.

Years	
1	.943396
2	1.836253
3	2.683710
4	3.490161
5	4.259391
6	4.094685
7	5.698900
8	6.374575
9	7.023925
10	7 648925
11	8. 2513
12	8.83272
13	9.39452
14	9.93800
15	10.46431
16	10.97452
17	11.46957
18	11.95034
19	12.43763
20	12.89217
21	13.33469
22	13.76568
23	14.17552
24	14.58536
25	14.98536
26	15.37598
27	15.75766
28	16.12079
29	16.48576
30	16.84290

The Uſe of this Table you will ſee by the enſui Examples.

E

Example 1. How much preſent Money muſt be aid for an Annuity or Rent of 100 *l. per Ann.* to ontinue for five Years, Rebate being made at the ate of 6 *l.* for 100 *l.* for one Year at Simple-Intereſt?

Look into Table the Third, and you will find in he Column againſt 5 Years 4.25939 + and then take he Rent or Annuity, which is here 100, and by ultiplying them you will find the Anſwer to be 25 *l.* 18 *s.* 9 *d.* ¼ very near.

	l. *s.*
The given Sum	100 : 00
ive Years Tabular Number	4.2593 +

```
   4.25939
       100
───────────  l.   s.   d.
425.93900 = 425 : 18 : 9 ½.
```

Examp. 2. A Gentleman going to Travel, hath Leaſe of 18 Years yet to come, of the yearly alue of 175 *l.* to be ſold for ready Money, and e Purchaſer is to be allowed Rebate after the Rete of 6 *l. per Cent. per Ann.* Simple-Intereſt, I ould know the preſent worth of this Leaſe?

```
Years Tabular Number   11.950341 }
he given Sum 175             175 } multiply
                      ──────────
                        59751705
                       83652387
                       11950341
                      ──────────
                     2091|309675
```

So that by this Work you find the Anſwer to b 2091 *l.* 6 *s.* 0 *d.* $\frac{3}{4}$ very near.

There might have been made Tables for othe Rates of Intereſt, but *Simple-Intereſt* being ſeldo allowed in the purchaſing or valuing Leaſes o Annuities, they being generally purchaſed at *Compound-Intereſt*; for at *Simple-Intereſt*, an Annuity wil be over valued, ſo ſaith Sir *Jonas More*, Sir *Samue Moreland*, and Mr. *Kerſey* writeth, That all Computations of Annuities or Leaſes, ought to be lai aſide as uſeleſs, and therefore I forbear, and procee to *Compound-Intereſt.*

CHAP. XXVII.

Compound-Intereſt.

Compound-Intereſt or *Intereſt* upon *Intereſt*, i when any Sum of Money is Lent, and th Intereſt when due, not paid, but kept i the Borrowers Hands, is by that Mean become a Part of the Principal, then it is called *Int* *reſt* upon *Intereſt*.

As for Example. If *A.* lend to *B.* 100 *l.* at the Ra of 6 *l. per Cent.* for a Year, and he pays not his ſai Intereſt of 6 *l.* it is then very reaſonable that *B* Debt then muſt be increaſed to 106, and if this b continued in *B*'s Hand, till the End of the ſeco Year, there will then be due to *A*, the Increaſe o 106, (to wit) 112 *l.* 7 *s.* 2 *d.* $\frac{1}{4}$, which will becom a new Stock for the third Year if not paid.

Whereby it is plain, That if it be lawful to take ereſt at all, it is lawful to take *Compound-Intereſt.*

An Illuſtration of an Example upon this Rule, (I l work both Vulgar and Decimal) by reaſon I uld make all things as plain and eaſy as I can.

So if 300 *l.* be put out at 6 *l. per Cent. per Annum* ereſt upon Intereſt for 4 Years, what will it then ount unto?

Operation by Vulgar Arithmetick.

at 6 *per Cent.* Anſwer, as by the Operations

6 *l.* *s.* *d.*

378 : 14 : 9 ¾.

00

eaſe the 2d Year. *l.* *s.* *d.*

18 : 0 : 0 318 : 0 : 0

6 19 : 1 : 7

08 : 0 : 0 337 : 1 : 7 | Increaſe 2d Year.

20

The 3 Year

60 337 : 1 : 7

12 6

20 20 | 22 : 9 : 6

4 | 20

80 4 | 49

| 12

l. *s.* *d.*

5 | 94 337 : 1 : 7

| 4 20 : 4 : 5 ¾

3 | 36 357 : 6 : 0 ¾

Increaſe 3d Year.

```
     357 : 6 : 0 ¼
                 6
  ─────────────────
  21|43 : 16 : 4 ½
    |20
  ────
   8|76                    l.    s.   d.
    |12                   357 :  6 : 0 ¼
  ────                     21 :  8 : 9
   9|16                  ───────────────
    | 4                   378 : 14 : 9 ¼
  ────                   ───────────────
   0|66
  ────
```

This ſaid laſt Queſtion performed Decimally.

$$100.106 :: \left\{\begin{array}{l} 300 \\ 318 \\ 337.08 \\ 357.3048 \end{array}\right\} \left\{\begin{array}{l} 318 \\ 337.08 \\ 357.3048 \\ 378.743088 \end{array}\right.$$

378.743088

l. s. d.

Which is 378 : 14 : 10 ½.

Whereby you ſee that 300 *l.* being put to Intereſt after the Rate of *6 l. per Cent.* will at the firſt Year's End be increaſed to 318, and being put out for the ſecond, Year will be increaſed to 337.08; and again this 337.08 being made a Principal, and being put out at the ſame Rate for the third Year will be augmented to 357.3048; and at the fourth Year's End it will amount unto 378.743088, which is the Number required by the Queſtion.

From what has been ſaid by Way of Explication the following Table 1ſt, is deduced the Uſe, and Conſtruction is afterwards declared.

Tab

Years.	Table the Firſt. *Shewing the Amount of onePound for 31 Years at 5 and 6* per Cent. *Compound-Intereſt.*		Table the Second. *Shewing the Rebate of onePound for 31 Years at 5 and 6* per Cent. *Compound-Intereſt.*	
	5	6	5	6
1	1.050000	1.060000	.925381	.943396
2	1.102500	1.123600	.907030	.889996
3	1.157625	1.191016	.863838	.839619
4	1.215506	1.262477	.822703	.792093
5	1.276281	1.338225	.783526	.747258
6	1.340096	1.418519	.746215	.704960
7	1.407100	1.503630	.710683	.665057
8	1.477455	1.593848	.676839	.627412
9	1.551328	1.689479	.644609	.591898
10	1.628895	1.790848	.613913	.558394
11	1.710339	1.898298	.584679	.528787
12	1.795856	2.012196	.556837	.496969
13	1.885649	2.132928	.530321	.468839
14	1.979932	2.260904	.505068	.442301
15	2.078928	2.396558	.481017	.417265
16	2.182874	2.540352	.458111	.393647
17	2.292018	2.692773	.436296	.371364
18	2.406619	2.854339	.415520	.350343
19	2.526950	3.025599	.395734	.330513
20	2.653298	3.207135	.376889	.311804
21	2.785962	3.399564	.358942	.294155
22	2.925261	3.603537	.341849	.277505
23	3.071524	3.819750	.325571	.261797
24	3.225102	4.048935	.320067	.246978
25	3.386355	4.291871	.295302	.232998
26	3.555673	4.549383	.281246	.219810
27	3.733456	4.822346	.267848	.207368
28	3.920125	5.311687	.255093	.195630
29	4.116135	5.458388	.242946	.184556
30	4.321942	5.743491	.231377	.174110
31	4.538039	6.088101	.220359	.164254

Queſt. 1. What will 250 *l.* amount unto bei forborn ſeven Years, Intereſt upon Intereſt, bei computed at the Rate of 5 *l.* *per Cent.* *per An* which is thus found out ?

Firſt, looking into the firſt Column of the fi Table, which hath the Figure 5 placed at the Hea of it, I find right againſt 7 Years the Numb 1.407100, which ſhews that 1 *l.* being continue 7 Years at 5 *l.* *per Cent. per Ann. Compound-Intere* and all forborn until the End of 7 Years, will be aug mented unto 351.775000, that is 351 *l.* 15 *s.* 8 *d.* + (which is to be found out by multiplying the tabul Number 1.407100 by the Number of Money forbo which in this Queſtion is 250 *l.* See the Work.

1.407100
250

70355000
2814200

l. *s.*
351.775000 that is 351 : 15 :

Queſt. 2. If 4325 *l.* 15 *s.* 6 *d.* be put out *Compound-Intereſt* for 12 Years, at 6 *l.* *per Cent. per A num,* what is the full Sum I muſt then receive (th is) both Principal and Intereſt at the End of the ſa 12 Years ?

Anſwer, 8704 *l.* 6 *s.* 0 *d.* ¾.

The Work.

4325.775 the Money put out at 6 *l.*
2.012196 Table Number.

25954650
38931975
4325775
8651550
4325775
86515500

l s. d.
8704.307151900 that is 8704 : 6 : 0 ¼.

Queſt. 3. What will 200 *l.* amount unto forborn Years, at the Rate of 6 *l.* *per Cent.* Compound-tereſt.

Anſwer 267 *l.* 12 *s.* 3 *d.* +

1.338225 Tabular Number.
200 Money.

267|645000 Anſwer, 267 *l.* 12 *s.* 3 *d.*

Table 2d. *Of Rebate at Compound-Intereſt.*

There is a Debt of 958 *l.* 15 *s.* 7. which is not e until 9 Years hence; but 'tis agreed to be paid preſent Money, what Sum muſt the Creditor re-ve, allowing the Rebate or Diſcompt of 6 *l.* *per nt. per Ann.*

Look into Table the 2, and againſt 9 Years at 6 *l.* *Cent.* you wil find this Tabular Number .591898, ich being multiplied by 958.78, the Product will 567.49996444=567 *l.* 10 *s.*

The Work .591898
958.78

4735184
4143286
4735184
2959490
5327082

l. s.
567|49996444=567 : 10

Let it be required to find how much ready Mone will diſcharge a Debt of 378 Pounds, payable a the End of 4 Years at the Rate of 5 *l. per Cent.* Compound-Intereſt ?

Look into Table the Second againſt 4 Years, a the Rate of 5 *l. per Cent. per Annum*, you will fin this Tabular Number .822703. which being multiplied by 378 is 310.9817.

.822703
378

6581624
5758921
2468109

l. s. d.
310|981734 or 310 : 19 : 3 *fer*

Take another Example for the Uſe of the ſecond Table.

What ready-Money will pay a Debt of 36 *l.* 10 due 21 Years hence at 5 *l. per Cent.*

Tabular Number .358942
36.5

1794710
2153652
1076826

l. s.
Anſwer, 13 *l.* 2 *s.*+ 13|1013830=13 : 2
1

Tabl

Years.	**Table the Third.** *Shewing the preſent Worth of* 1 l. *Annuity to continue for* 31 *Years at* 5 *and* 6 p. Cent. *Comp. Intereſt.*		**Table the Fourth.** *Shewing what Annuity to continue for* 31 *Years* 1 l. *will purchaſe at* 5 & 6 p.Cent.*Comp.Int.*	
	5	6	5	6
1	0.952381	0.943396	1.050000	1.060000
2	1.859410	1.833392	.537805	.543637
3	2.723248	2.673012	.367208	.374110
4	3.545950	3.465105	.282012	.288591
5	4.329477	4.212363	.230952	.237396
6	5.075692	4.917324	.197017	.203363
7	5.786373	5.582381	.172820	.179135
8	6.463212	6.209792	.154722	.161036
9	7.107821	6.801691	.140690	.147022
10	7.721734	7.360086	.129505	.135868
11	8.306414	7.886873	.120389	.126793
12	8.863251	8.383843	.112825	.119272
13	9.393572	8.852682	.106456	.102960
14	9.898640	9.294983	.101023	.107585
15	10.379658	9.712248	.096342	.102963
16	10.837769	10.105894	.092270	.098952
17	11.274065	10 477258	.088699	.095445
18	11.689586	10.827602	.085546	.092356
19	12.085320	11.158115	.082745	.089621
20	12.462209	11.469920	.080242	.087184
21	12.821152	11.764075	.077996	.085004
22	13.163002	12.041580	.075970	.083045
23	13.488573	12.303377	.074137	.081278
24	13.798641	12.550356	.072741	.079679
25	14.093944	12.783354	.070952	.078227
26	14.375184	13.003164	.069564	.076904
27	14.643033	13.210531	.068292	.675697
28	14.898127	13.406162	.067122	.074592
29	15.141073	13.500719	.066045	.073579
30	15.372450	13.764829	.060505	.072649
31	15.592810	13.929984	.064132	.071792

There is no Difference betwixt the Uſe of theſe Tables, and thoſe going before; as will be ſeen in the Manner of the working of theſe Tables.

As for EXAMPLE.

An Annuity of 80 *l. per Ann.* clear from all Taxes and Incumbrances whatſoever to be ſold for 12 Years, what ready Money is it worth, to be purchaſed at 5 *l. per Cent.* Compound-Intereſt?

Table the 3d. Tabular Number over-againſt 5 *l. per Cent.* and over againſt 12 Years is 8.863251, then multiply by 80, the given Annuity.

8.863251
80

	l.	*s.*	*d.*
709|060080	709 :	0 :	4

So the Anſwer is 709 *l.* 0 *s.* 4 *d.* +

A Gentleman ſells an Eſtate of 100 *l.* a Year clear to be paid yearly for 21 Years at the Rate of 6 *l. per Cent.* Compound-Intereſt, what ready Money muſt he receive?

Table 3. Tabular Number anſwering to 2 Years

21 Years——11.764075
100

1176|407500

Anſwer, 1176 *l.* 8 *s. fere.*

A Tabl

TABLE the Fifth:

A Table ſhewing the Amount of one Pound Annuity for 30 Years, or under forborn, at 5, 6, 7 or 8 Years Compound-Intereſt.

—	4	6.	7	8
1	1.00000	1.00000	1.00000	1.00000
2	2.05000	2.06000	2.07000	2.09000
3	3.15250	3.18360	3.21490	3.24640
4	4.31012	4.37461	4.43994	4.50611
5	5.52563	5.63709	5.75073	5.86660
6	6.80191	6.97531	7.15329	7.33592
7	8.14200	8.39383	8.65402	8.92280
8	9.64910	9.89746	10.25980	10.63662
9	11.02656	11.49131	11.97798	12.48755
10	12.57789	13.18079	13.81644	14.48656
11	14.20678	14.97164	15.78359	16.64548
12	15.91712	16.86994	17.88845	18.97712
13	17.71298	18.88213	20.14064	21.49529
14	19.59863	21.01506	22.55048	24.21492
15	21.57856	23.27596	25.12902	27.15211
16	23.65749	25.67252	27.88805	30.32428
17	25.84036	28.21287	30.84021	33.75022
18	28.13238	30.90565	33.99903	37.45024
19	30.53900	33.75999	37.37896	41.44626
20	33.06595	36.78559	40.99549	45.76196
21	35.71925	39.99272	44.86517	50.42292
22	38.50521	43.39228	49.00573	55.45675
23	41.43047	46.99582	53.43614	60.89329
24	44.50199	50.81557	58.17667	66.76475
25	47.72709	54.86451	63.24903	73.10593
26	51.11345	59.15638	68.67646	79.95441
27	54.66912	63.70576	74.48382	87.35076
28	58.40258	68.52810	80.69769	95.33882
29	62.32271	73.63979	87.34652	103.96593
30	66.43884	79.05818	94.46078	113.28321

The Uſe of this ſaid Table the Fifth will be madc manifeſt, and eaſily comprehended by the Manner of ſolving theſe Queſtions following.

Queſt. 1. If an Annuity of 30 *l.* payable by yearly Payments for 16 Years, be all forborn or unpaid, until the End of the ſaid Term, what will it then amount unto upon a Computatation of Intereſt upon Intereſt, at the Rate of 6 *l. per Cent. per Ann.*

Anſwer, 770 *l.* 3 *s.* 2 *d.* + as by the following Operation is evident.

Tabular Number	25.67252
The Money given	30
	770|17560
	770 *l.* 3 *s.* 2 *d.* +

Queſt. 2. What will an Annuity of 120 *l. per Ann* amount to, forborn 7 Years at 7 *l. per Cent.* Compound Intereſt?

8.65402
120

17308040
865402

1038|48240

Anſwer, 1038 *l.* 9 *s.* 2 *d.*

Queſt. 3. An annual Rent of 365 *l.* paid yearl and diſcontinued to be paid for 12 Years, is to paid; what will it then amount unto at the End the ſaid Term. at the Rate of 5 *l. per Cent.* Compound-Intereſt?

Tabular Number 15.91712
365

7958560
9550272
4775136

5809|74880

Anſwer 5809 *l.* 15 *s.*+

* * *

Queſtions to exerciſe the Rules, and Tables aforegoing.

ueſt. 1. HOW many Years Purchaſe will an Annuity (iſſuing out of an Eſtate) or 21 Years, to begin preſently, be worth, if it were o be ſold for ready Money, at the Rate of 6 *l. per ent.* accounting Intereſt upon Intereſt. Thus, Seek in the Column of Table the Third for 21 ears, and you will find againſt 21 Years this Num- 1.764075, which ſhews you, that the ſaid Annuity worth 11 Years ¾ Purchaſe, if at 8 *l. per Cent.* then o Years Purchaſe.

Queſt. 2. A Landlord lets a Leaſe of a Houſe nd Land in the Country for 21 Years, and it is greed to take 100 *l.* for that Leaſe, and a yearly Pay- ent of 30 *l.* what Fine or preſent Money muſt the enant give, to bring down the Rent to 10 *l. per nn.* agreed on both Sides to accompt at 6 *l. per nt.* Intereſt upon Intereſt.

Direction.

Subtract 10 from 30, there will remain 20 *l.* then ſeek in the Column of Table the Third, and againſt 21 Years, you will find 11.764075, which being multiplied by 20, the Product gives the Landlord the preſent worth.

Anſwer, 235 *l.* 5 *s.* 7 *d.* $\frac{1}{2}$.

Thus found 11.764075
20

235|281500=235 *l.* 5. 7 *d.* $\frac{1}{2}$

Queſt. 3. A Gentleman hath a Mind to diſpoſe of the Rent of a Houſe of 25 *l.* a Year for 8 Years, at 6 *l. per Cent.* Compound Intereſt, payable by yearly Payments, what is it worth in ready Money by Table the Third?

Table the Third againſt 8 Years 6.209792
25

31048960
12419584

Anſwer, 155 *l.* 4 *s.* 10 *d.* 155|244800

Queſt. 4. A Landlord demands a Fine, or preſent Sum, for a Leaſe of 127 *l. per Ann.* to continue 7 Years, what is the Sum he muſt receive, agreeing at the Rate of 6 *l. per Cent.* Compound-Intereſt.

Tabular Number, the 3d is 5.58238
by 127

3907666
Anſw. 708 *l.* 19 *s.* 2 *d.* $\frac{3}{4}$. 1116476
558238

l. *s.* *d.*
708|96226=708: 19: 2

Que

Queſt. 5. What Annuity, to begin preſently and to ontinue 12 Years, 500 *l.* in preſent Money will purhaſe, Compound-Intereſt being computed at 5 *l. per Cent. per Annum*?

Tabular Number the 4th is .112825
Money 500

Anſwer, 56 *l.* 8 *s.* 10 *d.* 56|412500

For as the Value found is in Proportion to the ſupoſed Annuity, ſo is the Sum of Money propounded o the Annuity required.

Queſt. 6. It is required to find the preſent Worth f 10 *l.* for eleven Years, at 6 *per Cent.* Compound ntereſt?

By Table the 3d againſt 11 Years, Tabular Numer is 7.88687
10

nſwer, 78 *l.* 17 *s.*+ 78|86870

Queſt. 7. A Gentleman has 9 Years to come in a eaſe of 175 *l.* a Year, and he is deſirous to enlarge is time eleven Years more (*viz.* to enjoy his Leaſe 0 Years yet to come,) I deſire to know, what Sum f Money muſt he pay down for that Purchaſe, to e allowed at the Rate of 6 *l. per Cent.* Compoundntereſt.

Direction.

In the firſt Place you muſt find what 175 *l. per Ann.* to be let for 11 Years, which are to begin after Years are expired, of that Leaſe at 6 *l. per Cent.* ompound-Intereſt, ready Money: Therefore 175 *l.* Year for 11 Years is 1380 *l.* 4 *s.* +

Thus found by Table the Third.

Tabular Number 7.88687
Money 175

3943435
5520809
788687

l. *s.*
1380|20225 =1380 : 4+

Thus you find, that 1380 Pounds 4 Shillings, th preſent worth, ſuppoſing the Rent were immediat ly entred upon: But becauſe it is not ſo, therefor your next Work muſt be to find, what Principal o Sum of Money, being put out to Intereſt for nin Years Diſcount at 6 *l. per Cent.* Compound In tereſt.

Look into Table the Second, that ſheweth th Rebate of Money, and againſt nine Years, and yo find Tabular Number .591898
1380

47351840
1775694
591898

l. *s.*
816|819240=816 : 16 +

Anſwer 816 *l.* 16 *s.* 4 *d* is the true preſent wort of that Leaſe in Reverſion, as was required in yearl Rents.

Queſt. 8. One would beſtow 630 *l.* to purcha a preſent yearly Rent, or Annuity of 60 *l.* to b paid by yearly Payments, the Queſtion is to know how many Years, the ſaid Annuity ought to be con tinued, Compound-Intereſt at 6 *l. per Cent. per Ann.* eing allowed on both Sides.

Anſwer, 17 Years and 23 Days, near.

Thus,

irſt divide 630 by 60, the Quotient will be 10.5.

60)630(10.5
60..

—

30

Which ſhews, that 10 Years and a half purchaſe are ven for the Annuity; then ſearching for 10.5 in able the Third in the Column of 6 *l. p. Cent.* I find not exactly, but the neareſt leſs than it is 10.47725 hich ſtanding right againſt 17 Years, and the next eater than 10.5. is 10.82760, which is placed ainſt 18 Years; from whence I infer, that the Annuity uſt continue 17 Years and more; yet leſs than Years. Now the proportional Parts of a Year be added to 17 Years, may be found out near e- ugh for Uſe: Thus by ſubtracting the ſaid leſſer abular Number 10.47725 from the greater 10.82760

10.47725

—

Reſt .35035

—

lſo ſubtracting 10.47725 from
10.50000 the Remainder gives
10.47725

—

.2275 near 23 Days.

Anſwer, 17 *Years* 23 Days, near.

Queſt. 9. There is a Leaſe of certain Lands worth *l.* a Year more than the Rent paid to the Lord it, of which Leaſe 7 Years are yet to come; but Leſſee is deſirous to take a Leaſe in Reverſion for 21 Years, to begin when his old Leaſe is e pired.

The Queſtion is, what Sum of Money is to b paid for this Leaſe in Reverſion, accounting Com pound-Intereſt at *6 l. per Cent.*

Anſwer, 250 *l.* 7 *s.* 2 *d.*

Thus found,

Firſt, by Table the 3d, find out how much 32 yearly Rent for 21 Years is worth in ready Mone as if the 21 Years were to begin preſently at 6 *per Cent.*

Tabular Number 11.764075
Money 32

23528150
35292215

l. *s.*
376|450300 = 376 : 9

Then by Table the Second, find what 376.4503 due at the End of 7 Years to come, is worth in rea Money, ſo will it be 250 *l.* 7 *s.* 2 *d.*

Table the Second.

.665057
376.45

3325285
2660228
3990342
4655399
1995171

l. *s.* *d.*
250|36070765 = 250 : 7 2

So that by taking this 250 *l.* 7 *s.* 2 *d.* which t Reverſion is worth, after your 7 Years are expire

o

of the 376 *l.* 9 *s.* which the whole 28 Years is
rth; you rebate for your 7 Years in being 126 *l.*
10 *d.* ſo that then there will remain the ſaid
l. 7 *s.* 2 *d.* which is to be paid in ready Money
make up your Leaſe 21 Years.

Queſt. 10. Suppoſe there was paid 3205 *l.* 5 *s.*
an Annuity, or a Leaſe of 250 *l.* a Year, to con-
e 21 Years, what Rate of Intereſt *per Cent.* is al-
ed to the Purchaſer.

Anſwer 5 *l.*

Thus found,

ivide 3205.2500 by 250, and the Quotient is
8210.

```
250)32052500(12.8210
     250 .....
     ---
     705
     500
     ----
     2052
     2000
     ----
      525
      500
      ---
      250
      250
      ---
       00
```

hen looking for 12.8210 in Table the 3d, in a
t Line paſſing from 21 Years, equi-diſtant to the
d Line of the Table I find 12.821152, which
ds in the Column of 5 *l. per Cent.* whence I con-
e, That 5 *l. per Cent. per Ann.* is the Rate of
reſt allowed to the Purchaſer.

Queſt. 11. A young Merchant, being beyond th Sea, at his Return of 26 Years, found that his Broth at his Deceaſe had left him from the ſaid Time of Years an Eſtate of 30 Pounds a Year, which had be received annually by the Executor, to be laid o according to the Will, for the Advantage of h Brother.

Now the Queſtion is to know, what was then d to the ſaid Merchant at his Return from the Se Compound-Intereſt being computed at 6 *l.* *per Ce* *per Ann.*

Firſt, know what Principal will in one Year ga 30 Pounds.

l. *l.* *l.*
If 6 *l.* Intereſt make 100 —— what will 30
30
—— *l.* *l.*
6)3000(500 Anſwer, 50

Then by the Table the Firſt, to know, what Years will come to, I find the Tabular Number gainſt 26 Years 4.54938. Then

l. *l.*
If 1 ———— 4.54938 —— what 500
500
———— *l.* *s.*
2274|69000 Anſwer, 2274 : 13

From which if you ſubtract 500 *l.* the Princip there will Remain 1774 *l.* 13 *s.* 3 *d.* due to the M chant at his Return.

l.	*s.*	*d.*
2274	13	3
500	00	0
1774	13	3

ueſt. 12. Laſtly, There is a Leaſe of certain ds to be let for 14 Years for 250 *l.* Fine, and . yearly Rent. But the Tenant is deſirous to leſs Rent, *viz.* 20 *l.* *per Ann.* and ſo to give a ter Fine; the Queſtion is, what Fine ought to aid in ready Money, to compute at 5 *l.* *per Cent.* *Annum* Compound-Intereſt.

irſt find the Difference between the Rents, which be 24 Pounds.

44
20
———
24 Diff.

Then by Table 3d, ſeek what Annuity or t of 24 *l.* *per Ann.* to continue 14 Years, is th in ready Money at 5 *l.* *per Cent per Annum*, ſo will find

ular Number 9.898640
24 Years.
————
39594560
12797280
————
237|561360 Anſwer, 237 *l.* 6 *d.*+
————

Which ſaid 237 *l.* 6 *d.* being added to the Fine *l.* gives 487 *l.* 6 *s.* to be paid down, to Anſwer Queſtion.

250 firſt Fine.
237 ſecond Fine.
——— *l.*
487 : 6
———

How

How to find out Tabular Number for Years exceeding 30.

IT oftentimes falls out, that the Number of Ye proposed in a Queſtion, may exceed the Nu ber of Years limited in the foregoing Tables: In ſu Caſes, that Defect may be ſupplied by the Meth uſed in the Solution of the following Queſtions.

Queſt. 1. Suppoſe 100 *l.* were put out to Inter at 5 *l. per Cent.* Compound-Intereſt for 40 Yea what will it then amount to?

This Queſtion is thus to be anſwered, Take a two Numbers, which make up 40 in the firſt Ta of this Book, and in the Column of 5 *l.* *per C* which ſtands againſt thoſe two Numbers, and mu ply them together, and then multiply that Prod by 100, the given Sum, and the laſt Product will your Anſwer.

As ſuppoſe 30 and 10, or 26 and 14, or 29 a 11; but we will pitch upon 30 and 10, and the Ta lar Number againſt 30 is 4.321942, and againſt 1 1.628895, which two Numbers being multipli produce 703|996484660=773 *l.* 19 *s.* 4 *d.* near.

By the Operation thus:

bular Numbers 4.321947 } multiply
1.628895 }

3889746
3457552
3457552
864388
2593164
432194

7.0399648466 Product of the Tabular (Numbers.
100

	l.	s	d.
703|9964846600 =	703 :	19 :	4

hus the Anſwer for 100 *l.* put out to Intereſt upon reſt, at 5 *l. per Cent.* for 40 Years, amounts unto *l.* 19 *s.* 4 *d. fere.*

he Anſwer would have been the ſame, if you had hed upon any two Numbers to have made o. And for Trial hereof let us pitch upon 26 14, the Tabular Number againſt 26 is 3.555673 againſt 14 is 1.979932.

Tabular Number againſt 26 is 3.555673.
Tabular Number againſt 14 is 1.979932.

By Table the Firſt.

```
        3.555673 } multiply
        1.979932 }
     ----------------
        7111346
       10667019
      32001057
     32001057
    24889711
   32001057
   3555673
   ------------------
   7039990754236
             100
   ---------------------    l.   s.  d.
   703|999075423600 = 703 : 19 : 4
   ---------------------
```

Thus you ſee the Anſwer is the ſame.

Take another *Example;* Suppoſe 456*l.* to be pay at the End of 56 Years to come, what is it at ſent Worth, Rebate being allowed at 5 *l. per* Compound-Intereſt ?

This Queſtion is to be anſwered in the ſame M ner, as thoſe belonging to Table the Second.

The given Time being 56 Years, I pitch upo and 26, and the Tabular Number againſt 30 .231377, and that againſt 26 is 281246. which be multiplied by one another.

Thus,

```
         .231377
         .281246
       ---------
         1388262
         925508
        462754
       231377
      1851016
      462754
  --------------
    .065073855742
              456
  ----------------
     390443134452
    325360278710
   260295422968
  ----------------
   29|673588218352
  ----------------
```

                l.   s.   d.
Anſwer, 29 : 13 : 3

There is a Debt of 258 *l.* 15 *s.* 7 *d.* which is not until 48 Years hence, but they do agree to pay n preſent Money, what Sum muſt be paid in dy Money, the Rebate or Diſcount, at 6 *l. per* *t. per Annum?*

The Number of Years being 48, I take 28, and 20 for the Numbers.

Look into Table the Second againſt 28 Years, you ſhall find .195630, and againſt 20 Years .311804.

```
              .195630}
              .311804}multiply
              --------
               782520
             15650400
             195630
            195630
           586890
          ------------
          .609982165200
                 258.78
          ------------
          4879857321600
         4269875156400
        4879857321600
       3049910826000
      1219964330400
      --------------------
      157.85118471045600
      --------------------
```

l. s.
Anſwer, 157 : 17+ as by the Operation.

Agai

Again, if 540 *l.* be put forth at 5 *l. per Cent.* Compound Intereſt, and both Principal and Intereſt be forborn until the End of 45 Years, what will then be due?

The Number of Years being 45 I take 15 and 30, then looking into

Table the firſt againſt 30, is 4.321942
And againſt 15, is 2.078928

4.321942
2.078928

34575536
8643884
38897478
34575536
30253594
86438840

8985006238176 the Increaſe of 1 *l.* forborn (45 Years.
540

35940024952704O
44925031190880

4851|9033686150 40=4851 : 18 : 4

l. *s.* *d.*
Anſwer, 4851 : 18 : 4 very near, as by the Operation.

And that there may be nothing wanting to make this Book as perfect, and beneficial to all Gentlemen in their ſundry Capacities, I have here inſerted, out of Dr. *Newton's Scale of Intereſt*, a Table that will prove very ready and uſeful, for the caſting up and proportioning Fines, in the renewing of Leaſes, held from Cathedral Churches, and Colleges in the Univerſities, as ſhall be made manifeſt by the Manner of ſolving the two following Queſtions.

Queſtion the Firſt.

If a College-Tenant hath 7 Years yet to come, o unſpent in a Leaſe of Lands for 21 Years, at 1*l* yearly Rent, and deſires to have 14 Years renewed or added to thoſe ſeven Years, and ſo to take new Leaſe for 21 Years, to begin preſently, wha muſt he pay for a Fine?

Anſwer, 3 *l.* 3*s.*

From 7.77507 (being the Number which anſwe to 21 Years in this 6th Table) ſubtract always th Tabular Number, which belongs to the Number c Years to come or unſpent in the old Leaſe; ſo th Remainder will ſhew, what Fine muſt be paid fo the Years to be renewed or added, to make tho unſpent Years in the old Leaſe to be 21 Years com pleat again, at one Pound yearly Rent.

So to ſolve the Queſtion propoſed.

From the preſent worth of 1 *l.* yearly Rent for 21 Years which is } 7.775

Subtract the preſent worth of the ſame Rent for 7 Years (that were unſpent in the old Leaſe.) } 4.625

And there will remain the Fine ſought, to wit } 3.149

Th

l.

That is to ſay, 3.14967 or 3 l. 3 s. 0 d. (very near) muſt be paid as a Fine, for renewing or adding 14 Years to 7 Years, that were unſpent in the old Leaſe, the yearly Rent being 1 l. alſo the ſaid 3.14967 ſhews that ſuch a Renewal is worth 3 Years Purchaſe, and near $\frac{15}{100}$ Parts of a Year's Purchaſe, whatever the Rent be.

Queſtion the Second.

If a Tenant that hath 17 Years yet to come in a Leaſe of Lands, held of a College for 21 Years, at 0 l. yearly Rent, be deſirous to renew 4 Years, and ſo make thoſe 17 Years to be 21 Years again compleat, at the ſame Rent, what muſt he give for a Fine?

Anſwer 23 *l.* 17 *s.* 2 *d.* 1 *f.*

Table the 6th.
Shewing the preſent Worth of one Pound Annuity, for any Number of Years under 22, at the Rate of 11 l. 11 s. 8*d.* 1 $\frac{3}{10}$ f. per Cent. *Compound-Intereſt.*

Years.	*Preſent Worth.*
1	0.90034
2	1.69938
3	2.41922
4	3.06438
5	3.64262
6	4.16088
7	4.62540
8	5.04176
9	5.41496
10	5.74948
11	6.04934
12	6.31819
13	6.55907
14	6.77507
15	6.96868
16	7.14226
17	7.29786
18	7.43737
19	7.56243
20	7.67455
21	7.77507

For according to the Rule before given.

From the preſent Worth of 1 *l.* yearly Rent for 21 Years.	7.77587
Subtract the preſent Worth of the ſame Rent for 17 Years, that were unſpent in the old Leaſe	7.29716
And there will remain	0.47721
Which multiplied by the Rent	50
	23|86050

The Product will be the Fine ſought to wit, 23 *l.* 17 *s.* 2 *d.* 1 *f.*

Queſtions of this Nature may be readily ſolved, without the Loſs of $\frac{1}{16}$ Part of a Years Purchaſe, by the Help of the foregoing Table the Seventh, fo the Benefit of ſuch as underſtand not Decimal Fractions.

As for EXAMPLE.

If a College-Tenant deſireth to have ten Years added to eleven Years, that are yet to come or unſpent in a Leaſe, that may make up his Leaſe to 21 Years, he muſt give for a Fine one Years Purchaſe, and 2 Quarters of a Year's Purchaſe, and 3 Quarters o a Year's Purchaſe.

Suppoſing the Rent to be 48 *l. per Ann.* the Fin may be computed thus:

TA

TABLE the 7th.

	Years.		*Years.*		*Years Purchaſe.*	*Quarters of a Year.*	*Quarters of a Quarter.*
The Fine for renewing or adding	1	to	20	is valued at	0	0	1
	2	to	19		0	0	3
	3	to	18		0	1	1
	4	to	17		0	1	3
	5	to	16		0	2	2
	6	to	15	is valued at	0	3	0
	7	to	14		1	0	0
	8	to	13		1	0	3
	9	to	12		1	1	3
	10	to	11		1	2	3
	11	to	10	is valued at	2	0	0
	12	to	9		2	1	1
	13	to	8		2	2	3
	14	to	7		3	0	2
	15	to	6		3	2	1
	16	to	5	is valued at	4	0	2
	17	to	4		4	2	3
	18	to	3		5	1	1
	19	to	2		6	0	1
	20	to	1		6	3	2

	l. *s.* *d.*
One Year's Rent is	48 : 0 : 0
Half a Year's Rent.	24 : 0 : 0
Three Qtrs of a Quarter of a Year's Rent.	9 : 0 : 0
The Sum is the Fine required	81 : 0 : 0

Whence it appears, That the Tenant muſt give 81 *l.* as a Fine, for adding of 10 Years to 11 Years, that were expired in this old Leaſe, to the end he may have a new Leaſe for 21 Years compleat.

In like Manner, the Fine for renewing 7 Years to 14, that are unſpent in a Leaſe of Lands, to the End there may be a new Leaſe for 21 Years in being, is valued at one Year's Purchaſe preciſely, which is the fundamental Proportion aſſumed in calculating the ſaid Table the Sixth, as before was ſaid.

The like may be done for renewing any other Term of Years under 21, at any Rent propoſed.

An Explication or Meaning of ſuch Notes or Characters, which for Brevity ſake, are uſed in the enſuing Queſtions.

CHaracters, are Marks, Signs, Notes, or Symbols of Things invented by Artiſts, and peculiar to ſeveral Sciences, by which the Knowledge of Things themſelves is always moſt expeditiouſly, and moſt times more clearly, conveyed to the Learner, eſpecially after he hath entred himſelf to them.

Characters uſed by Arithmeticians, are chiefly theſe that follow:

+ *Addition* is thus noted, ſignifying, that the Number which followeth ſuch Sign is to be added to the Number preceding it; ſo 4+8 implieth that 8 is to be added to 4, 'tis called the affirmative and poſitive Sign, and is directly contrary to the following Sign.—

— Is the Note of Negation, or *Subtraction*, ſignifying that the Number which followeth ſuch Sign, is to be ſubtracted from the Number preceding it; ſo 8—5 ſignifieth the Difference between 8 and 5, or 5 to be ſubtracted from 8.

× Is the Character of *Multiplication*, and ſignifieth, that the Numbers, between which it is placed, are to be multiplied together, as 7 × 4 ſignifieth, that 7 and 4 are to be multiplied together.

= This Character is a Sign of Equality, and is
iverſally uſed for equal to, as $3+6=7+2$ ſigni-
h, that 3 and 6 are equal to 7 and 2; alſo $5+9$
14; likewiſe $18-6=4+8=12$.

$>$ This Character is a Sign of Majority, ſigni-
ng that the Number on the Left-hand of ſuch
gn, is leſs than the Number on the Right-hand
reof; ſo $5>3$ implieth, that 5 is greater than 3

$<$ This Character is the Sign of Minority, ſig-
ying that the Number on the Left-hand of ſuch
n, is leſs than the Number on the Right-hand
reof; ſo $3<5$ implieth, that 3 is leſs than 5.

$\surd$ This Character or $\surd q.$ ſignifieth the Square-
t of the Number which followeth it, ſo $\surd$ 144,
plieth the Square-root of 144, to wit 12.

$\surd c$ This Character ſignifies the Cube-root of the
mber which followeth it; ſo $\surd c.$ 1728, ſignifies
Cube-root of 1728, which Cube-root will be
nd to be 12.

÷ Is the Character of *Diviſion* thus, $_{8}$ ſignifieth,
t 12 is to be divided by 8: Some Authors ex-
ſs it thus 8) 12(——

:: Is the Character for Arithmetical Proportion.

: Is the Character of Geometrical Proportion
junct, and is uſually placed between two Pair of
portionals, as in the Rule of 3; thus 4.6 :: 8.12,
ſhews that 4 hath the ſame Proportion or *Ratio*
, that 8 hath to 12.

What

What is meant by Proportion.

1. Proportion is firſt, when two Quantities a compared one with another, in reſpect of the Greatneſs or Smallneſs ; that Compariſon is calle *Ratio*, Reaſon, Rate, or Proportion : But wh more than two Quantities are compared, then t Compariſon is more uſually called the Proportio they have to one another.

2. If of four Numbers given, the firſt be to t Second, as the Third is to the Fourth ; theſe fo are called proportional Numbers.

3. Therefore, if four Numbers be Proportiona the Product of the Means, is equal to the Produ of the Extreams : So theſe Numbers following a called Proportionals, *viz.*

$$4 \times 6. \quad 6 :: 4 \times 9. \quad 9$$
$$\tfrac{2}{3} \times 12. \quad 12 :: \tfrac{2}{3} \times 15.\ 15$$

That is to ſay, 4 times 6 (or 24) is ſaid to ha ſuch Proportion to 6 ; as 4 times 9 (or 36) hath 9. In like Manner, $\frac{2}{3}$ of 12 (or 8) hath ſuch P portion to 12, as $\frac{2}{3}$ of 15 (or 10) hath to 15 ; fro hence ariſeth the *Rule of Three* ; or for the Exc lency thereof, is called the *Golden-Rule.* Th Things being premiſed, underſtood, and remembre I proceed to the Solution of Choice and Select Q ſtions.

CHAP. XXVIII.

Queſtions.

Collection of pleaſant and ſubtil Queſtions, to exercise all the Parts of Vulgar Arithmetick, both in whole Numbers and Fractions; to which are added practical Queſtions about the Menſuration of ſuperficial Figures aud Solids.

Examples of the Rule of Three *mixtly uſed.*

eſt. 1. A Grocer will beſtow 183 *l. viz.* in Cloves at 4 *s.* 2 *d. per* ℔. Mace at 7 *s.* 6 *d.* Cinamon at 3 *s.* 8 *d.* Nutmegs at 12 *s.* 3 *d.* d Pepper at 2 *s.* 10 *d. per* ℔; and he would have many Pounds of one Kind as of another: The eſtion is, to know how many Pounds muſt he ve?

Anſwer, 120 ℔. 1 *oz.*

s.	*d.*
4 :	2
7 :	6
3 :	8
12 :	3
2 :	10
10 :	05

l. *s.* *d.* ℔ *l.*
1 : 10 : 5 buy 1 ———— 185

Or,

d. ℔ *d.*
365 ———— 1 ———— 43920

℔ *oz.*
365)43920(120. $\frac{120}{365}$ $\frac{24}{73}$ = 1. $\frac{19}{365}$.

Queſt. 2. *A*, *B*, *C*, and *D*, have 100 *l.* *Sterling*, be divided amongſt them, in ſuch Sort, that as as *A.* hath 3 *l.* *B.* muſt have 5 *l.* and as oft as hath 5 *l.* *C.* muſt have 7 *l.* and as oft as *C.* hath *D.* muſt have 10 *l.* what muſt each have?

Add the Proportionals into one Sum.

Thus	3	Then if	25 : —100 :: 3	12
	5		25 : —100 :: 5	20
	7		25 : —100 :: 7	28
	10		25 : —100 :: 10	40
	25		Proof	100

Queſt. 3. If 60 Gallons of Water do in 1 Hou Time fall into a Ciſtern containing 200 Gallons, by a Pipe in the ſame Ciſtern, there run out 45 G lons in the Hour, how many Hours will it be bef 'tis filled.

Anſwer, in 13 Hours and 20 Minu

60 filling Cock
45 empties
15 Diff.

Gall. *Hours* *Gall.*
15 —— 1 :: 200
h.
15)200(13.^{1} = 20 Minutes
15..
50
45
5 $\frac{5}{15}|\frac{1}{3}$

Queſt. 4. Two Footmen, *A.* and *B.* depart fr one Place, and both go one Road, but *A.* goes Days before *B.* and travels 30 Miles a Day, *B.* lows after, and travels 50 Miles a Day, in how m Days travel will *B* overtake *A*?

B.

B. 50 30
A. 30 3

20 Exceſs. 90 Miles which *A.* hath travelled at *B's* ſetting out.

M. *D.* *M.*
Then if 20 : 1 :: 90

ſwer, *B.* will overtake him t the End of 4 Days, and half, and will have travelled 225 Miles.

$20)90(4\frac{1}{2}.$
80

10

For 50.
By $4.\frac{1}{2}$

200
25

225 Miles.

Queſt. 5. If 20 Sheep feed in a Paſture 40 Weeks 10 *s.* how many Sheep for 15 *l.* for 12 Weeks, can t into the ſame Paſture?

s. *Sheep* *s.*
f 10 : 20 :: 300
20

*6*000

)6000(*6*00 Sheep.

W. *Sheep.* *W.*
Then if 40 : *6*00 :: 12
40 *Indirect Rule of* 3.

12)24000(2000 Sheep.

Anſwer, 2000 Sheep.

Queſt *6.* A Herring and a half for 3 Half-pence, many for 11 Pence?

1 *d.* $\frac{1}{2}$

d. *Herring* d.

1. $\frac{1}{2}$ buy 1. $\frac{1}{2}$ what will 11

4 2 4

6 3 44

3

132

2)

6)132(22(11 *Her*

(*ring*

o o

Queſtion 7. When 120 Oranges are bought 2 a Penny, and 120 Oranges at 3 a Penny, and p together and ſold 5 for 2 Pence, what is gained loſt?

Anſwer 4 *d.* loſt.

Or. *d.* *Or.* *Or.* *d.* *Or.*

2——1 :: 120 3——3 :: 120

Anſwer, 5 *s.* Anſwer, 3 *s.* 4

Then ſell them together.

Or. *d.* *Or.* *s.* *d.*

5——2 :: 240 8 : 4 the Oranges co

8 : 0 Sold for.

Anſwer, 8 *s.*

0 : 4 Pence loſt.

Queſt. 8. A Draper gave 155 *l.* for 17 Cloths *Blackwell-hall*, how muſt he ſell by the Piece, gain 10 *l. per Cent.*

l. *l.* *l.*

100——10 :: 155

Anſwer, 15 *l.* 10 *s.*

Cloths *l.* *s.* *Cloth* *l.* *s.*

Then 17——170 : 10——1 155 : 00

15 : 10

l. *s.* *d.*

Anſwer, 10 : 0 7. $\frac{1}{17}$. 170 : 10

Queſt.

ueſt. 9. If a Wedge of Gold weighing 17 ℔. $\frac{2}{7}$ of *-weight*, be worth *679.* $\frac{5}{7}$ *l. Sterling*, what is the ue of 1. $\frac{3}{13}$ Grain of that Gold. Anſwer, 2 *d.*

First, 1. $\frac{3}{13}$ ($\frac{16}{13}$ of $\frac{1}{24}$ of $\frac{1}{20}$ of $\frac{1}{12}$ = $\frac{1}{4680}$.

Secondly, $\frac{121}{7}$ . . . . . $\frac{4758}{7}$ :: $\frac{7}{120}$ = 2 *d.*

For 20 is $\frac{1}{20}$ of $\frac{1}{12}$
12
———
d.
240 120)140(2 for Anſwer.

ueſt. 10. A Man dying, gave to his eldeſt Son $\frac{1}{4}$ =($\frac{1}{6}$ of his Eſtate; to his ſecond Son $\frac{1}{5}$ of $\frac{1}{2}$ $\frac{1}{10}$) and when they had counted their Portions, one had 40 *l.* more than the other; the Remain- of the Eſtate was given to the Wife and younger ldren, I would know, what was the Portion of eldeſt Son, alſo of the ſecond, and how much belong to the Wife and younger Children?

		l.
Anſwer,	The eldeſt Sons Portion	100
	The ſecond Son's Portion	60
	And 440 *l.* for the Wife and Children.	

Thus found,

$\frac{6}{60}$ — $\frac{10}{60}$ = $\frac{4}{60}$ | $\frac{1}{15}$

(Portion.
hen If $\frac{1}{15}$ . . . . . . $\frac{40}{1}$ :: $\frac{1}{10}$ ($\frac{60}{1}$ the ſecond Son's

he Difference of their Portions being 40 *l.* there- by Conſequence, the eldeſt Son's Portion muſt oo *l.*

to find out the Wife and younger Childrens Portions ſay,

If $\frac{1}{15}$ . . . . $\frac{40}{1}$ :: $\frac{1}{1}$ ($\frac{600}{1}$

aſtly, *600*—*160*=440 *l.* that is to ſay, take *160* *l.* of *600* *l.* and there will remain 440 *l.* for the Wife younger Children.

Queſt. 11. A young Merchant receiv'd 66 *l.* which was $\frac{2}{3}$ of $\frac{1}{2}$ of his elder Brother's Portio was 1 $\frac{1}{4}$ times of his Father's Eſtate, the Queſtion i what was the Father's Eſtate? Anſwer, 560

1. If $\frac{1}{3}$ - - - - - 66 $\frac{2}{3}$ :: $\frac{1}{1}$ (200 *l.* the elde
l. Brother's Portio

2. 200 X 3 $\frac{1}{2}$ =700

For

200
7
———
1400   (2(1400(700

Then

If 1 $\frac{1}{4}$ - - - - $\frac{200}{1}$ :: $\frac{1}{1}$ (560*l.* the Father's Eſta

Queſt. 12. Two depart from one Place, the o Eaſtward and the other Weſtward, the one trave leth 3 Miles a Day, and the other 5 Miles a Da how far are they diſtant the ninth Day after the Departure? Anſwer, 72 Miles.

Here their firſt Days Diſtance is added togethe which makes 8, and then it is 1 - - - 8 :: 9 (7

Queſt. 13. There are 30 Cloths bought for 70 *l.* a are ſold for 80 *l.* Now if they had coſt 80 *l.* ho ſhould they have been ſold to have gained after t ſame Rate? Anſwer, 91 *l.* 8 *s.* 5

l. *l.* *l.*
If 70 Stock—80—:: 10
10
——— *l.* *s.* *d.*
70)800(11 - $\frac{30}{70}$ = 8 - 5
70
———
140   Thus, 80+11 - 8 - 5
70   11
———   ————
30   91—08 - 5

Queſt. 14. A Man going a Journey, his firſt ays Travel was 5 Miles, his laſt Days travel was 5 Miles, he increaſed his Journey every Day three iles, how many Days did he travel?

Anſwer, 11 *Days.*

The Second 35
The firſt 5

3)30(10+1=11

Queſt. 15. If *A.* can finiſh a Work in 20 Days, d *B.* in 30 Days, in what Time will the Work be iſhed by *A.* and *B.* working together?

Anſwer, 12 Days.

Firſt, find what Quantity of Work will be done each Workman, in one and the ſame Time, then d 1 or the whole Work to the Time, wherein h Work will be finiſhed by both Workmen working ether.

Thus,

Days *Work* *Days* *Work*

If $\frac{30}{1}$ - - - - - $\frac{1}{1}$ :: $\frac{20}{1}$ ($\frac{2}{3}$ +
add 1

Anſwer, $\frac{20}{30}|\frac{10}{15}|\frac{2}{3}$ 1. $\frac{2}{3}$

Hence it appears, that if they worked together, Days will finiſh that Work once, together with the ſame Work; therefore by the *Rule of Three* again,

Works *Days* *Work.*

If 1 $\frac{2}{3}$——20 :: $\frac{1}{1}$ Anſwer, 12 Days.

$\frac{5}{3}$——$\frac{20}{1}$ :: $\frac{1}{1}$

5)60(12 Days.

After the ſame Manner this Queſtion is performed.

Queſt. 16. A Drunkard drinketh a Barrel of ſtron Beer in 14 Days, but when his Wife drinketh wit him, he drinketh it out in 10 Days, in what Tim would his Wife drink it out alone?

Anſwer, 35 Days.

Days *Days* *Days*
14 Then if 4 give 10 what will 14
10 10
——— ———
4 140

4)140(35 Days.

Queſt. 17. What is the $\frac{1}{8}$ Part of a Ship wort when the $\frac{1}{}$ is valued at 1015 *l.* —40 *s*?

l. *l.* Anſwer 253 *l.* 5 *s.*

1015—2=1013

$\frac{8}{2}$ ——— $\frac{1013}{1}$ :: $\frac{1}{8}$

l. *s.*
8)2026(253. $\frac{2}{8}$=$\frac{1}{4}$=5

Queſt. 18. There is a Ship to be fitted out 60 Men, to the *Weſt-Indies*, and victualled for Year (52 Weeks or 365 Days) and each Man is be allowed $\frac{3}{4}$ of a Gallon of Beer a Day, and 7 kets. There are every Week 2 Beef-days, 2 Po days. 3 Fiſh-days, 7 ℔. of Beef is allowed amo 4 Men, every Beef-day, 7 ℔. of Pork every P day, and 2 Quarts of Peaſe, $\frac{1}{5}$ of a Ling, 2 Ou of Butter, and $\frac{1}{4}$ ℔. of Cheeſe every Fiſh-day.

Now what Proviſions muſt be laid in of each ort, and what will the Proviſions amount to at the ollowing Rates?

Beer 40 *s per* Tun.
Beef 22 *d. per* Stone.
Biskets 2 *s.* 8 *d. per C.* 112 ℔. to the Hundred.
Fiſh 1 *s.* 9 *d. per* Couple.
Butter 12 *s. per* Firkin, the Firkin 56 ℔ Weight.
Cheeſe 1 *l.* 2 *s. per C.* at 112 ℔. to the Hundred.
Pork 1 *s.* 4 *d. per* Stone, 8 ℔. to the Stone.
Peaſe, 2 *s.* 6 *d. per* Buſhel.

Anſwer.

		l.	*s.*	*d.*
er	65 *Tuns,* 45 *Gallons*	130	07	01
skets	1368 *Hundred-weight*	182	08	00
ef	1365 *Stone*	125	02	06
rk	1365 *Stone*	91	00	00
aſe	97 ½ *Buſhels*	12	03	09
ng	936 *Couple*	81	18	00
tter	20 *Firkins*	12	10	08
eeſe	20 C. 3 *qrs.* 16 ℔.	22	19	07
		658	09	07

This Ship carries 28 *Pieces of Ordnance,* viz.

3 Demi-culverins of 16 ℔. Bullet.
4 Whole Culverins of 12 ℔.
6 Demi-Culverins — 10 ℔.
8 Sakers — 7 ℔.
3 Falcons — 4 ℔.
2 Faulconets — 1 ¾ ℔.
2 Minion Cuts — 1 ½ ℔.

Queſtion the 18th continued.

How many Pounds of Powder will diſcharg theſe Pieces 50 times over, when to ſhoot a *Bull* of 1 ℔. weight, there is allowed $\frac{1}{2}$ a Pound of Pow der; Now what doth the Powder amount to, 4 *l.* 7 *s.* 6 *d.* *per* C.

Anſwer, 5762. $\frac{1}{2}$ Pounds of Powder, to diſcharg theſe Pieces 50 times over, and the Powder 4 *l.* 7 *s.* 6 *d.* *per* C. amounts to 225 *l.* 1 *s.* 11 *d.*$\frac{43}{11}$

Thus found, as by the Operations.

Beer,
3 Quarts.
60 Men.
———
180 Quarts *per* Day.
365
———
900
1080
540
——— 63 4 *Tuns Gall.*
4)65700(16425(260(65 : 45
126··· 24··
———
382 20
378 20
———
45

Queſtion the 18th continued.

Biskets.

7
60

420 Biskets a Day.
365

2100
2520
1260
Stone
112)153300(1368 : $\frac{3}{4}$
· · · :
84

Beef.

Men ℔. *Men*
4 —— 14 —— 60
14

240
60
Stone
4)840(210 Beef 1 Week.
: · · 52

420
1050

10920 Beef.

8)10920(1365
Stone

The like Quantity for Pork, 1365 Stone.

Queſtion the 18th continued.

Peaſe.

Men *Quarts* *Men*
4 —— 4 :: 60
4
———
4)240(60
52
———
120
360
———
3120 Quarts.

8 *Buſhels*
4)3120(780(97 $\frac{1}{2}$
72
———
60
156
———
4 $\frac{4}{8}$|$\frac{2}{4}$|$\frac{1}{2}$

Ling.

. One Fifth every Fiſh-day amongſt 4 Men: There
are three Fiſh-days, *per* Week?

$$\frac{1}{5} \times \frac{4}{1} = \frac{4}{5}$$

$$5 \times \frac{3}{1} = \frac{12}{5}$$

Men *Men*
4 —— $\frac{12}{5}$ —— $\frac{60}{1}$

$\frac{720}{20} = \frac{36}{1}$ Fiſh for 1 Week.

$\frac{12}{1}$ 5
60 4
——— ———
720 Num. 20 Denom.

Week *Fiſh* *Weeks*
1 —— 36 :: 52
36
———
312
156
——— (Lin
1872 who
Qu

Couple
2)1872(936

Queſtion the 18th continued.

Butter.

Two Ounces of Butter each Day to 4 Men, there are 60 Men.

oz.
2
4
———
8
3
———
24 Ounces each Day.

Men *oz.* *Men*
4———24——— :: 60
60
———
4)1440(360 Ounces in one Week.

Week *oz* *Weeks*
1———360——— :: 52
52
———
720
1800
——— 56 *Firk.* ℔.
16)18720(1170(20 : 50
50

Queſtion the 18th continued.

Cheeſe.

One Fourth of a Pound of Cheeſe every Fiſh-day, amongſt four Men there are 60 Men.

$\frac{1}{4}$ X by $\frac{4}{1}$ = 1 *l.*

1
3 Fiſh-days

3 *l.* each Fiſh-day.

Men *l.*
4 —— 3 :: 60 Men (45 Pounds of Cheeſ
(a Week

45
52

C. *qrs.* ℔.
112)2340(20 . 3 : 16 Cheeſe.

100

qrs. ℔.
$\frac{100}{112}$ = 3 : 16

As for the Powder. Vide *the Queſtion.*

℔. ℔.
16 X 3 = 48
12 X 4 = 48
6 X 10 = 60
8 X 7 = 56
3 X 4 = 12
2 X 1.$\frac{3}{4}$ = 3.$\frac{1}{2}$
2 X 1 $\frac{1}{2}$ = 3

Total —— 230 . $\frac{1}{2}$

They ſhoot 230 ℔. $\frac{1}{2}$ at one Shooting.

Then 230'
By 50

11500
25

11525

℔.
1 Powder $\frac{1}{2}$ ℔. —— 115

230

2
2)23050(11525(5762. $\frac{1}{2}$ o
Powder to di
charge the Guns 50 times ove
Th

Then for the Coſt and Price.

l. *l.* *s.* *d.* *l.*
112——4 . 7 . 6 :: 5762. ½

l. *Pence* *l.*
112——1050 :: 5762.¹

Anſwer, 225 *l.* 1 *s.* 11 : $\frac{42}{112}$.

Queſt. 19. In Arithmetical Progreſſion.

1 . 2 . 3 . 4 . 5 . 6 . 7 . 8 —*Arith. Proport.*
2 . 4 . 8 . 16 . 32 . 64 . 128 . 256--*Geo. Proportion.*

A certain Mercer ſold 20 Yards of lvet, to be paid for in 12 Weeks, by ithmetical Progreſſion; that is, to wit, receive the firſt Week 6 *s.* the ſecond *s.* the third Week 18 *s.* and ſo forward, reaſing the Number of Weeks by ſix illings, till the twelfth and laſt Week re expired; the Queſtion is, how many unds he muſt have for his 20 Yards Velvet?

Then multiply the Number of Places your firſt Number, and it gives you r Anſwer in Shillings.

	Weeks.
6	1
12	2
18	3
24	4
30	5
36	6
42	7
48	8
54	9
60	10
66	11
72	12

6 add the 1*ſt Number.*
78

78
6
46|8 Shill.
33|8

Anſwer, 23 *l.* 8 *s.*

Queſt. 20. One hundred Stones are ſo placed every one a Yard diſtant from another, and one Yar diſtant from a Basket, how many Miles muſt he ru to take up the Stones, one after another, ſtill returning to the Basket and putting them in?

Here the firſt, third, and fourth Terms, are given to find out the fifth.

By this general Rule, from the Product of th third, into the fourth, ſubtract the 4th, and to th Remainder add the Double of the firſt, half the Product of that Sum multiplied by the third, gives th fifth for Anſwer.

The third 100
The fourth 2
200
The fourth 2
Reſt 198

Double of the 1ſt 4
Multiplied by
the 3d gives $=\frac{20200}{2}=$ 10100 Yards.

Or
$200+2=202$
100
Yards
2)20200(1010

And 10100 Yards divided by 1760 gives in th Quotient $5.4\frac{1}{4}$ Miles, which is exactly $\frac{1}{4}$ —8 of Mile.

Geometrical Progreſſion.

Queſt. 21. Suppoſe I ſold a Horſe after this Man-r, the Horſe had four Shooes, in every Shoe ere were ſix Nails, in all 24 Nails; and he was ntent to pay a Half-penny for the firſt Nail, and uble it to the laſt, what ought he to pay for the orſe?

See the Work plainly demonſtrated.

1	1
2	2
4	3
8	4
16	5
32	6
64	7
128	8
256	9
512	10
1024	11
2048	12
4096	13
8192	14
16384	15
32768	16
65536	17
31072	18
62144	19
24288	20
48576	21
97152	22
94304	23
88608	24

The whole Proceſs of the Queſtion is plainly ſet forth, by ſetting down the Number of Nails, and increaſing in a Geometrical Proportion, by doubling each Number; I find at laſt, it amounteth unto 16777216 Half-pence, and by abating always the firſt Number which is here, 1 it is 16777215 Half-pence, which being reduced into Pounds, Shillings, and Pence, it maketh 34952 *l.* 10 *s.* 7 *d.* $\frac{1}{2}$ at a Half-penny *per* Nail, 17476 *l.* 5 *s.* 3 *d.* $\frac{3}{4}$ at a Farthing a Nail.

A very great Price for a Horſe.

The laſt Sum 8388608 multiplied by 2, the Product will amount unto 16777216, from which ſubtract the firſt Number 1, and then it is 16777215.

Queſt. 22. Suppoſe a Footman, *A.* running every Day 40 Miles, is purſued the fourth Day, after, by another (ſuppoſe *B.*) 50 Miles a Day; in how many Days, and after how many Miles Travel will *A.* be overtaken? Anſwer, at the End of 12 Days.

Subtract 40 from 50, reſt 10 Miles, the clear Gains of 1 Day; but becauſe *A.* was gone 3 Days Journey before *B.* ſet out, that is 120 Miles before *B.* purſued. Then ſay,

Miles *Day* *Miles* *Days*
If 10 ——— 1 :: 120 ——— 12
1|0)120(12

Day *Miles* *Days* *Mtles*
Then ſay, If 1 —— 50 :: 12 (600
12
———
600

600 Miles that *B.* muſt go, before *A.* be overtaken.

Queſt. 23. A Merchant would beſtow 160 *l.* in Cloves, Mace, and Nutmegs; the Cloves at 4s *per* ℔. Mace at 12 *s. per* ℔. and Nutmegs at 6s the Pound; now he would have of each Sort a equal Quantity, how many Pounds muſt he have o each Sort? Anſwer, 236 *l.* 5 *oz.* $\frac{11}{9}$+

s. *s.* ℔. *l.* ℔. *oz.*
4 22 —— 1 :: 160 22)5200(236 : 5.$\frac{9}{11}$
12 20 44
6 ——— ———
— 5200 80
22 ——— 66
— ———
140
132
———
8

Queſt. 24. A Merchant gave to four Beggars 20 *s.* iz. to *A*, B, *C*, *D*; to *A* $\frac{1}{3}$, to *B* $\frac{1}{4}$, to *C* $\frac{1}{5}$, and *D* $\frac{1}{6}$?

Here according to the Queſtion.

A. had	6 : 8	
B. had	5 : 0	
C. had	4 : 0	
D. had	3 : 4	
Sum	19 : 0	

But the Sum to be paid ought to be 20 *s.* therefore 12 *d.* or 1 *s.* muſt be divided into ſuch Proportion, as the Parts bear to one another.

Wherefore reduce the Fractions $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, to $\frac{1}{6}$, into common Denominator, and they will be $\frac{20}{60}$, $\frac{15}{60}$, $\frac{2}{0}$, $\frac{10}{60}$, and neglecting the common Denominator, dd the Numerators into one Sum, which will be 7; then the Proportion is,

			s.	d.		far.
s $\frac{57}{1}$ to $\frac{20}{1}$ *s.*	::	ſo 20 :	to 6 :	8	$\frac{20}{57}$	20.
		15 :	to 5 :	.	$\frac{15}{57}$	15
		12 :	to 4 :	.	$\frac{12}{57}$	12
		10 :	to 3 :	4	$\frac{10}{57}$	10
			add 1			57(1
		Proof	20 :	0		Fract. = 1 *s.*

Queſt. 25. **Two** Men *A.* and *B*, diſcourſing of heir Money; *A.* ſays to *B.* if I had two of your ieces, I ſhould have twice as many as you have; to hich *B.* replies, if I had two of yours, I ſhould have uſt as many as you have, how many had each?

Anſwer. $\begin{cases} A. \text{ had } 14 \\ B. \text{ had } 10 \end{cases}$

Suppoſe *A.* had 16, to which, 2 being added, akes 18, which is twice 9; but having taken 2

from thence, it muſt be by this Suppoſition that
had 11; wherefore 2 taken from 16, and added
11 makes 13, for *B.* and *A.* 14, therefore the Erro
too much by one.

For my ſecond Suppoſition.

Suppoſe *A.* had 20, then 20 + 2 = 22, that is
twice 11; bur from thence 2 being taken *B.* muſ
have 13. Now 2 from 20, and put to 13 gives 1
for *B.* and leaves 18 for *A*, which is not equal
therefore the Error again too much by 3.

The Operation.

48 28 20
16 — 20
X (14 *A.*
1 — 3
2

So that *A.* had 14 and *B.* 10.

PROOF.

$$\left.\begin{array}{l}14+2=16\\10-2=\ 8\end{array}\right\}\text{half.}$$

$$\left.\begin{array}{l}14-2=12\\10+2=12\end{array}\right\}\text{equal.}$$

Queſt. 26. A Man gave away his Eſtate in thi
Manner, to *A.* ½ and he gave back 10 *l.* to *B.* ⅓ an
he gave back 6 *l.* to *C.* ¼ and he gave back 4 *l.* laſ
of all he had 16 *l.* remaining, I demand his Eſtate?

Anſwer, 48 *l.*

r according to the Queſtion.
A. had 14
B. had 10
C. had 8

l.
In all 32 and 16 left 16
32

which makes 48

☞ A few Propoſitions in Military Orders, as to the Uſe of the Square-Root.

Examples of the Extraction of Roots.

Queſt. 27. To place any Number of Soldiers, ppoſe 36000) in ſuch Order of Battle, that there all be any Number in Rank or File: ſuppoſe 500 Rank, how many muſt there be in File?

Anſwer, 72.

RULE.

Divide the whole Number of the Army (36000,) the aſſigned Men in Rank or File, the Quotient ill be your Anſwer, and is the Number that will in File or Rank.

500)36000(72 Men
3500··
1000
1000
0

Queſt. 28. If 7396 Soldiers are to be placed in ſquare Battle, how many are to be ſet in Rank in File?

Anſwer, 86.

For the Square-Root of 7396 is 86.

```
  . .
 7396(86 Soldiers.
 64
 ----
166)996
    996
    ---
      0
```

Queſt. 29. Suppoſe 61504 Soldiers were to placed into a Square Battle?

Anſwer, 248 Men.

```
    . . .
    61504(248 Square-Root.
    4
    --
 44)215
    176
    ---
488)3904
    3904
    ----
      00
```

Queſt. 30. Admit 16928 Men were to be put to a double Battle?

RULE.

Extract the Root of half the Number of Me that is, 8464, whoſe Square-Root is 92: Therefo I ſay, that 92 Men muſt be placed in File, and 1 in Rank, to order that Number of Men into a doub Battle.

84

8464(92 Men, is the Square-root, and 184
81 Men in Rank to make up the double Battel.

182)364
364
0

For 92+92=184

Queſt. 31. Again, Suppoſe 1342 Soldiers were
o be put into a double Battel, I find 26 ought to
e placed in File, and 52 in Rank?

)1342(671
671(26
4
46)271
276
5 odd Men wanting to make the (Square.

26
2
52

Queſt. 32. To order any Number of Soldiers in-
o a Battel of the grand Front?

The Rule is here: For the Square-Root of the
Part of the Number given, will ſhew the Number
o be placed in File, and four times ſo many are to
e placed in Rank.

So 16900 Soldiers being to be put into that Or-
er, extract the Square-root of 4225 for that is the
of 16900, the Square-root is
5; therefore 65 muſt be placed
File, and 260 in Rank, to form
Battel of the Grand Front.

4225(65
36
125) 625
625
0

65+4=260 Men in Rank.

Queſt. 33. Any Number of Men, together with their Diſtance in Rank and File, being propounded, to order them into a Square Battel of Ground?

Admit 2500 Soldiers were to be placed into a Square Battel of Ground in ſuch ſort, that their Diſtance in File ſhould be 7 Foot, and in Rank 3 Foot; and 'tis required to know how many Men muſt be placed in Rank and in File, to draw up 2500 Men into a Square Battel of the Ground: Then ſay,

As 7——3 :: 2500(1071. $\frac{3}{7}$
Whoſe Square-root is 32

therefore I ſay, 32 Men are to be placed in Fil

Now to find how many Men are to be placed i Rank, divide 2500 by 32, the Quotient is 78 which is the Number of Men to be placed in Rank and 4 Men to be diſpoſed of elſe where.

32)2500(78 Men in Rank, and 4 odd Me
224 to be diſpoſed of.

260
256

4

Queſt. 34. Any Number of Soldiers propounde to order them in Rank and File, according to th *Ratio* of any two Numbers given?

Admit 6400 Soldiers are to be put in Array, ſuch Order, that the Number of Men placed in Fil ſhall bear ſuch Proportion to the Number in Ra as 7 is to 13.

7——13 :: 6400(11885

Whoſe Square-root is 109, *&c.* the Number Men to be placed in Rank, by which divide 640 it produces 58, the Number of Men to be placed in File, and 78 Men to be employed elſewhere.

Operation.

```
7——13 :: 6400
            13
         ─────
         19200
          6400
         ─────
       7)83200(11885
         ....

              5        . . .
109)6400(58            11885(109 Square.
     545..             1
    ────               ─────
     950           20)01885
     872                1881
    ────               ─────
  78 Men left.    209)  4 Men left.
```

Queſt. 35, Suppoſe the Wall of a Caſtle that is eſieged, is in Height 18 Feet, and there is a Moat ull of Water, that ſurroundeth the ſaid Caſtle, to be 4 Feet broad, what Length muſt a Scaling-Ladder, ave to reach from the outermoſt Side of the Moat o the top of the Wall?

Anſwer, 30 Feet (to wit the Square-root of the Sum of the Squares of 18 and 24.)

$$18 \times 18 = 324$$
$$24 \times 24 = 576$$
$$\sqrt{q}.\ 900 = 30$$

Order, is a Term in Military Diſcipline, being e equal Diſtance of one Rank or File from another; e uſual Order in Files is 3 Foot, and in Ranks Foot; the open Order is double in each.

Thus much ſhall ſuffice for the Uſe of the Square-Root, we will now proceed to ſome Uſes of the Cube-root.

Of the Cube-Root.

Queſt. 36. The chief Uſe of the Cube-root, is to find out a Proportion between like Solids, as Globes, Cylinders, Cones, *&c.*

What a Cube is, may be well repreſented by a Dye, which is a little Cube it ſelf, being a Rectangular, or Square Solid, that hath an equal Length, Breadth, and Depth, and is comprehended under ſix equal Squares; now if the Side of one of thoſe equal Squares (which is alſo the Side of the Cube) be 12 Inches, the ſuperficial Content will be 144 Square Inches, which being multiplied again by 12, produceth 1728 Cubical Inches.

As in theſe Examples.

If a Bullet of Lead of 6 Inches Diameter weigh 68 *l.* what ſhall a Leaden Bullet weigh, whoſe Diameter is 3 Inches.

The Rule.

As the Cube of the Diameter given, is to the Weight thereof, ſo is the Cube of the Diameter ſought to the Weight thereof.

The Work.

C. D. ℔. *C. D.*

216——68 :: 27

27

———

476

136

——— *l.*

216)1836(8.$\frac{108}{216}$ = $\frac{1}{2}$ ℔. *fere.*

1728

———

108

6 3

6 3

——— ———

36 9

6 3

——— ———

216 27

Queſt. If a Bullet, whoſe Diameter is 9 Inches, do weigh 72 Pounds, what will a Bullet of the ſame Metal weigh, whoſe Diameter is 6 Inches?

Anſwer, 21 ℔. $\frac{1}{3}$.

See the Work.

C. D. ℔. *C. D.*

729——72 :: 216

9	6	216
9	6	72
81	36	432
9	6	1512
729	216	

729)15552(21.$\frac{243}{729}$=$\frac{1}{3}$.
1458··
972
729
243

Fractions abbreviated.

$\frac{243}{729}$ | $\frac{81}{243}$ | $\frac{9}{27}$ | $\frac{3}{9}$ | $\frac{1}{3}$

Queſt. 38. If a Ship of 100 Tun be 44 Foot long at the Keel, of what Length ſhall the Keel be of a Ship of 220 Tun?

Anſwer, 57—225 Foot = $\frac{1}{4}$ Foot.

44	220
44	220
176	4400
176	4400
1936 Sq.	48400 Sq.
44	220
7744	968000
7744	96800
85184 Cube.	10648000 Cube

Tun *Cube of* 44 *Tun*
If 100——85184——ſo :: 220
220
——
1703680
170368
——
100)187404|80(187404$\frac{4}{5}$
——

Whoſe Cube Root is 57..225=$\frac{4}{5}$, the Length of the Keel ſought.

Queſt. 39. If the Breadth of a ſquared Piece of Timber, ſuppoſed to be ſtrait and terminated at both Ends by two equal Squares, be 2.55 Foot, the Depth alſo 2.55 Foot, and the Length 18.5 Feet, how many Cubick Feet are contained in that Piece of Timber?

Thus found.

2.55
2.55
——
1275
1275
510
——
6.5025 ſuperficial Feet
—— which is the Content of the Squares at the End of the Piece.

6.5025
18.5
——
325125
5.20200
65025
——
120.29625 which
—— is the Solid Content required.

Queſt. 40. If the Breadth and Length of a ſquare Piece of Timber, having equal ſquare Baſes be 1.7 Foot, how far ought one to meaſure along the Lengt of that Piece of Timber, to make a Foot Solid?

Anſwer, 326+ or $\frac{326}{1000}$ Parts of a Foot.

1.7

3.0625)1.0000000(.326+or 4 Inches
(very near.

91875..

81250
61250

200000
183750

16250

1.75
1.75

875
1225
175

.0625

Which **Decimal** is thus found, *viz.* firſt find the uperficial Content of the Baſe, which will be 3.0625: (For 1.75 multiplied by 1.75 produceth 3.0625.) Then dividing 1, (to wit 1 Solid Foot) by the Baſe .0625 the Quotient will be as you find by the Work o be .326+, or 4 Inches very near.

Queſt. 41. What is the Diameter of a Globe of tone, which contains four cubical or ſolid Feet?

Anſwer, 1.96 Foot.

For as 11 is in Proportion to 21, or as 1 is to .9090909, ſo is 4 (the ſolid Content given) to a ourth Proportional, to wit 7.636363+, whoſe Cubick-Root is 1.96 the Diameter required.

1———1.9090909(1.96
4

7.6363636(1.96 Cubick-root

Concerning the Gauging of Veſſels.

THE eaſieſt and apteſt Ways for Practiſe in Gauging, are thoſe which are performed by the Help of Tables, or Gauging-Rods, purpoſely compoſed upon ſliding Rules of nine Inches, or a Foot long, by which you may take the Dimenſions, and for that Purpoſe are very convenient.

However, not to omit to give the Reader of this Treatiſe, I ſhall here inſert ſome Queſtions by which the young Gauger may have ſome Light.

Concerning the Gauging of Brewers Veſſels.

Queſtion. 42. To find the *Area* of any ſquare Tun, Back, or Cooler, either in Ale or Wine Gallons.

RULE.

Multiply the given Length, or Breadth, into its ſelf, and the Product will be the *Area* in Inches; then divide that *Area* by 282, which gives you the *Area* in Ale-Gallons; and by 231, and the Quotient will give you in Wine Gallons.

As for EXAMPLE.

Suppoſe the Side of a Square Tun, Back, or Cooler, be 124.5 Inches, what will be its Content in Ale and Wine Gallons?

First,

ſt, 124.5 multiplied by 124.5 gives } *Area in Inches.*
n the Product } 15500.25
en 15500.25 divided by 282 gives } *Gallons*
the Quotient the *Area* in Ale-Gal. } 54.96 *Inches.*
d 15500.25 divided by 231 gives in } *Gallons.*
e Quotient the *Area* in Wine-Gall. } 76.10 *Inches.*

Gallons
So that the Anſwer is for Ale 54.96 *Inches.*
Gallons
And for Wine 76.10 *Inches.*

Note, That the Ale-Gallon contains 282 Cubical hes; and that a Wine-Gallon contains 231 Cubi- Inches.

Queſt. 43. Suppoſe a Cask, whoſe Diameter at Bung is 31.5, and at the Head 24.5, and its ngth 42 Inches, what will be the Content in Ale- llons and Wine-Gallons?

RULE.

nto twice the *Area* of the Bung-Circle, add the a of the Head-Circle: Multiply their Sum into third of the Length, and the Product will be the tent in their reſpective Gallons.

Thus found by the RULE.

t, 31.5 multiplied by 31.5, is ——— 1984.5
24.5 multiplied by 24.5 is ——— 600.25
in 1984.5 added to 600.25 maketh ——— 2584,75
2584.75 multiplied by 42 Inches maketh 108559.5
n 108559.5 divided by 1077.15 gives }
the Quotient the Content in Ale- } 100.78 *Ale*
allons ——— }

And 108559.5 divided by 882.35, gives in the Quotient the Content in Wine-Gallons———————— } 123.03 *Wi*

Anſwer, { 100.78 *Ale-Gallons.*
123.03 *Wine-Gallons.*

Queſt. 44. If the Diameter at the Head of Veſſel be 18 Inches, and at the Bung 32 Inches, a the Length is 40 Inches, what is the Content that Veſſel in Wine-Gallons ?

The RULE.

Having found the Difference of the two Diam ters at the Bung and Head of the Veſſel, take $\frac{7}{10}$ that Difference, and add it to the leſſer Diamete then ſquare that Sum and reſerve the Product; th done, if the Content be required in Wine-Gallon multiply the Product reſerved, this Decimal Fr ction .0034, and the Length of the Veſſel one in the other (according to the Rule of continual Mu tiplication) ſo ſhall the laſt Product be the Numb of Wine-Gallons required : But if the Content required in Ale or Beer Gallons, multiply the Pr duct before reſerved, this Decimal Fraction, .002 and the Length of the Veſſel, one into the other co tinually, ſo ſhall the Product be the Content in Al Gallons.

This Rule ſhall be explained by two Queſtio one in Wine-Gallons, and the other in Ale-Gallons

Exp

Explication.

Queſtion 45.

e Diameter at the Bung	32. 0
e Diameter at the Head	18. 0
eir Difference	14. 0
ich multiplied by $\frac{7}{18}$, that is	00. 7
e Product will be	09. 8
ich added to the leſſer Diameter ives the mean Diameter	27. 8
ich mean Diameter being ſquared (that is multiplied by it ſelf) pro- duced	772. 84
ich ſaid Product multiplied by	0.0034
e Product thence ariſing will be	2.6276+
ich multiplied by the Length of the Veſſel 40, *viz.*	40. 0
e Product is the Number of Wine-Gallons ſought, *viz.*	105.1040+

Anſwer, 105.1040+ Wine-Gallons.

Note, The Superficies of any Figure is uſually cal- l its *Area*.

Queſt. 46. If the Diameter at the Bung of a Barrel Ale be 25 Inches; the Diameter at the Head .5 Inches, and the Length 32.75 Inches, what is the ntent of that Barrel in Ale-Gallons?

Ex-

Explication.

The Diameter at the Bung ———————— 25. 0
The Diameter at the Head ———————— 20. 5
Their Difference ———————— 4. 5
Which multiplied by $\frac{7}{10}$ that is ———— 0. 7
The Product will be ———————— 3. 15
Which added to the leſſer Diameter gives the mean Diameter ———— 23. 65
Which mean Diameter being ſquared, that is multiplied by it ſelf, produceth 559.3225
Which Product multiplied by ———— 0.0027
The Product thence ariſing is ———— 1.5101
Which multiplied by the Length of the Veſſel produceth ———— 32. 75
The Product is the Number of Ale-Gallons ſought, *viz.* ———— 49. 452

Anſwer, 49.452 Ale-Gallons.

Upon thoſe Grounds that have been before recit and upon the Reaſon of the Rule to be granted, That in every Gallon of Wine there is 231 Cubi Inches, and 282 Cubick Inches are equal to an A Gallon: The Decimal conſidered as the Baſe of Wine-Gallon, or as 1 is to 0034, ſo is the Square the equated Diameter, to the ſuperficial Content that Circle in Wine-Gallons, and Parts of a Gallo And after the ſame Manner, ſuppoſing as before, 28 Cubick-Inches are equal to an Ale-Gallon, the D cimal .0027 preſcribed in the ſaid Rule will found out.

Upon thoſe Grounds Mr *Wingate* compoſed h *Gauging Rod*, the chief Uſe thereof, is only in takin of Dimenſions, and for that Purpoſe are very conv nient, and are now uſed with all Perſons engaged the Menſuration of Wine and Ale-Gallons.

But the particular Conſtructions of thoſe Rods, likewiſe the making of Tables for the ſame Pur-e, being handled by ſeveral Artiſts, I ſhall not in- upon them.

Theſe four Rules being only as an Eſſay to uging ; for to find the Capacities or Contents all Sorts of Veſſels, which hold Liquids, Meal, n, *&c.* deſerves a more than ordinary Study and ctice.

And ſo conclude.

f the Circumference of a Circle be 88.75, what he ſuperficial Content of that Circle ?

Anſwer, 626.801+

For as 1 is to .079578 ſo is the Square of the Cir-nference to the ſuperficial Content.

Therefore if .079578 be multiplied by the Square the given Circumference, the Product ſhall be the rficial Content ſought.

Operation.

```
1 ———————.079578——— ———7876.5625
                          07.9578
                        —————————
                        630125000
                       551359375
                      393828125
                     708890625
                    551359375
                  ———————————————
        Anſwer, 626.801 +
                  ———————————————
```

Scholium.

Scholium.

HAVING in the Chapter of *Intereſt upon Inte*
in *Decimal Arithmetick*, by the Tables and
the Pen, ſhewed the Manner of finding out t
Value of Rents, Annuities, and Penſions, after t
Rate of five or ſix Pounds *per Cent. per Ann.* by v
rious Operations.

However it may not perhaps be unacceptable
the Concluſion of this Book, (it being not alto
ther out of the Way of an *Arithmetician*) to inſ
a brief Account of ſome Eſtimates, that have be
reaſonably made by two very ingenious Perſons,
bout the Proportion or Difference of Men's Liv
according to their ſeveral Ages, which may be
good Uſe in computing the Values of Annuities,
taking of Leaſes for Lives, &c.

Sir *William Petty* in his Diſcourſe made before t
Royal Society (*Anno* 1674.) concerning the Uſe
Duplicate Proportion in the Life of Man, and
Duration; ſaith, That it's found by Experien
there are more Perſons Living of between 16 a
26 Years old, than of any other Age, or Decade
Years in the whole Life of Man, (*viz.* 70 or 80 Year
His Reaſon for that Aſſertion I ſhall omit; but ſupp
ſing it true, he thence infers, That the Roots of eve
Number of Mens Ages under 16 (under whoſe Ro
is 4) compared with the ſaid Number 4, doth ſhe
the Proportion of the Likelyhood of ſuch Me
reaching the Age of 70 Years.

As for Example. 'Tis 4 times more likely, th
one of 16 Years old ſhould live to 70, than a ne
born Babe: 'Tis 3 times more likely, that one

9 Ye

ears old, ſhould attain the Age of 70, than the Infant.

n the other Hand, 'tis 5 to 4, that one of 25 rs old, will die before one of 16; and 6 to 5, that of 36 will die before one of 25; and ſo on, acding to the Roots of any other declining Age, pared with (4, 6) the Root of 21, which is the r of Perfection, according to the Senſe of our w, and the Age for whoſe Life a Leaſe is moſt able.

. The ingenious and great Mathematician, Cap *Edmund Halley*, in *Philoſoph. Tranſact. Numb.* 196.) h with great Induſtry and Skill, draw an Eſtimate he Proportion of Mens Lives from the monthly les of the Province of *Sileſia* in the Kingdom of *mia*; from whence that excellent Man proves, 'tis 80 to 1, a Perſon of 25 Years old, will not in a Year; that it is 5 ½ to 1, that a Man of 40 live 7 Years; that a Man of 30 Years old, may onably expect to live 27 or 28 Years more.

Now for theſe and the like Proportions, he juſtinfers, that the Price of Inſurance upon Lives ht to be regulated, there being a great Diffee between the Life of a Man of 20 and one 50.

or Example, 'Tis 100 to 1, that if a Man of 20 not in a Year, and but 38 to 1, for a Man of Years of Age; and upon theſe alſo depends the luation of Annuities for Lives: For it is plain, t the Purchaſer ought to pay only ſuch a Part of Value of any Annuity, as he hath Chances that s living.

nd for that Purpoſe he hath taken the Pains ich was not a little) to compute the following le, that ſhews the Value of Annuities for every h Year of Age to the Seventieth.

Age

Age	*Purchaſe Years*	*Age*	*Purchaſe Years*	*Age*	*Purchaſe Years.*
1	10.28	25	12.27	50	9.21
5	13.40	30	11.72	55	8.51
10	13.44	35	11.12	60	7.60
15	13.33	40	10 57	65	6.54
20	12.78	45	9.91	70	5.32

The ſame ingenious Gentleman proceeds on, ſhews how an Eſtimate may be made to find Value of two Lives, and then of three Lives; whi being too long a Diſcourſe to be recited here, I ſh only add this ſerious Obſervation : *Viz.* How unju ly we repine at the Shortneſs of our Lives, think our ſelves wrong'd, if we attain not to Age; whereas it appears, That the one Half thoſe that are born, die in ſeventeen Year's Time.

For by the aforeſaid Bills of Mortality at *Breſl* it was found that 1238. were in that Time reduc to *616*; ſo that inſtead of murmuring at what call a ſhort Life, we ought to eſteem it as a gr Providence, that we have ſurvived, perhaps by ma Years, that Period of Life, whereat the one half the whole Race of Mankind does not arrive.

Soli DEO Gloria in Æternum.

FINIS.

A

COMPENDIUM

OF

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A
COMPENDIUM
OF
ALGEBRA.

SECTION I.

Definitions.

A*LGEBRA* is a Science by which all poſſible Propoſitions, either Geometrical, or Arithmetical, may be reſolved, by aſſuming the Quantity ſought, (whether it be a Number, or a ne, *&c.*) in a Queſtion, as if it were known ; d then with the help of one or more Quanti- s which are known at firſt, to which it muſt compared in various Manners, the ſaid Quan- y ſought is at laſt found equal to ſome Quanti- certainly known, and is therefore known alſo. Which Analytical Way of Reaſoning, pro- ceth in Concluſion either a Theorem, declar- ſome Property, Proportion or Equality, juſt- inferred from Things given, or granted in a

Propoſition, or elſe a Canon directing Infallibly how that may be found out or done which is deſired, and at that ſame Time diſcovers Demonſtrations of the Certainty of the reſulting Theorem or Canon; and is therefore juſtly eſteemed th moſt uſeful Art in the Commonwealth of Learnin

(2.) *Algebra* is either Numeral or Literal Numeral *Algebra*, is when a Queſtion is ſolved b Numbers; and Literal, when done by Symbols Letters or Species, repreſenting the Numbers o Quantities in a Queſtion.

(3.) Quantities in *Algebra*, are conſidered t be either Poſitive or Negative.

(4.) Poſitive or Affirmative Quantities, a thoſe that have real Value: And Negative Quantities thoſe that are oppoſite to the Poſitive, as to deſtroy an Equal Number of Poſitives whe added to them. Thus in human Affairs, Poſſeſions may be called Poſitive or Affirmitiv Quantities, and Debts Negative ones; and ſo i local Motion, Progreſſion towards a Point may b called Affirmative, and Progreſſion the contrar Way or from that Point, Negative Motion. Poſ tive Quantities are denoted by the Sign (+) Plu and Negative Quantities by the Sign (—) Minu and where no Sign is prefixed to a Quantity, Pl is underſtood.

(5.) When the Sign (+) ſtands between ny two or more Quantities, it denotes the Su of thoſe Quantities or that they are to be a ded, but when — ſtands between any two Quantities, it denotes the Difference, or that th are to be ſubtracted, thus, $a+b$ repreſents t Sum of the Quantities a and b and $a-b$ the r mainder or Difference, when the Quantity b ſubtracted from the Quantity a.

(6.) The Number of Times any Quantity taken muſt always be prefixed before the Qu

ti

y, and that Number is cal'ed its Co-efficient;
d if no Co-efficient be prefixed: Unite is un-
rſtood thus, $7x$ repreſents the Quantity x, ta-
n 7 times.

(7.) Simple Quantities are thoſe ſingle Letters,
ich repreſent the ſeveral Numbers, or Lines
a Problem, or thoſe which are not connected
+ or — to any other; Thus, $7aa$ and —
are ſimple Quantities.

(8.) Compound Quantities are ſuch as are ei-
r the Product, Sum, or Difference of two or
re Simple Quantities which are connected by
Signs + or —, thus $a+b$ and $3xy+4bc$
Compound Quantities.

(9.) Like or Similar Quantities, are ſuch as are
reſented by the ſame Letters equally repeated,
s $7x$ and $9x$ are Similar Quantities.

(10.) Unlike or Diſſimilar Quantities are thoſe,
ich are repreſented by different Letters, or Let-
unequally repeated, thus $5a$ and $6x$ alſo
and x^3 are Diſſimilar Quantities.

(11) When the Sign (×) ſtands between any
Quantities, it repreſents that the Quantities
to be Multiplied; but when the Sign (÷)
ds between any two Quantities it repreſents
the laſt ſhould be Divided by the Firſt of
ſe Quantities.

12.) This Sign (=) repreſents that the Sum
the ſeveral Quantities on the Left-hand of that
, are equal to the Sum of thoſe on the
ht, hence it is called the Sign of Equality.

13.) This Character $\surd$ is called a Radical
, and ſignifies that the Square Root of the
nber or Quantity is extracted, or to be extract-
but to deſign the Root of a higher Power,
Index of the Power is to be written over the
ical Sign, thus, $\sqrt[3]{aaa}$ ſignifies that the
e Root of aaa is to be extracted.

SECT. II.

Addition of Algebraick Integers.

Caſe 1. WHen the Quantities given to b added, are all repreſented b the ſame Letters, or like and have the ſam Signs.

(14.) *Rule.* Add the Co-efficients (or Figures o the Left-hand of the Letters) and annex th common Sign, and the common Letters.

Thus,

$$\begin{array}{ll|l|l|l|l}
\text{add} & +a & -2b & +3abx & -xy & 7abz\\
 & +a & -3b & +5abx & -xy & 3abz\\
 & \overline{+2a} & \overline{-5b} & +6abx & -4xy & 5abz\\
 & & & \overline{+14abx} & -5xy & 4abz\\
 & & & & \overline{-11xy} & \overline{19abz}
\end{array}$$

(15.) The Reaſon of this Rule is Evident, f in *Examp.* 1. *a* is a poſitive Quantity, and if be ſuppoſed to ſtand for 100 *l.* when add to another Poſitive *a*, will give 2*a* or 200 For the Figure on the left-Hand of t
*6 Quantities, * being the Number of times th Quantity is taken, therefore the Sum of thoſe F gures will be the Number or Sum of the whole.

(16.) *Caſe* 2. When the Quantities given to added, are all repreſented by the ſame Letters, b have unlike Signs. *Rule*, Sum all the Poſit Quantities, (as in Caſe the Firſt,) and the Ne tives, and ſubtract the Co-efficients of thoſe t Sums, and to the Remainder prefix the co on Letters, with the Sign of that whoſe Sum as greateſt.

Thus,

$$\left.\begin{array}{r}+6xy\\-7xy\end{array}\right\}\text{The Sum of the Poſitives } +16xy$$

$$\left.\begin{array}{r}+10xy\\-3xy\end{array}\right\}\text{The Sum of the Negatives } -10xy$$

The Difference or Sum required $+6xy$

again,

$$\begin{array}{lr}\text{to} & +17xyz\\ \text{add} & -10xyz\\ \hline & +7xyz\end{array}\qquad\begin{array}{lr}\text{to} & +2a\\ \text{add} & -2a\\ \hline & 0\end{array}\qquad\begin{array}{r}-15ab\\+10ab\\ \hline -5ab\end{array}$$

$$\begin{array}{ll}\text{Alſo} & -10abc\\ & +14abc\\ & -12abc\\ & +8abc\\ & -12abc\\ \hline & -34abc \text{ Sum of the Negatives.}\\ & +22abc \text{ Sum of the Poſitives.}\\ \hline & -12abc \text{ Difference or Sum required.}\end{array}$$

(17.) That to add a Negative to an Affirma- e is the ſame as to Subtract a Poſitive from Poſſitive, appears from the Definition * of Po- *4 ive and Negative Quantities, and in the Affairs Life may be proved thus: Suppoſe a Man orth 1000 *l.* Real or Poſitive Eſtate, but being Surety for his Friend, a Debt of 200*l.* charged to his Account, that 200 *l.* is Ne- tive Eſtate, and being added to his Poſitive tate, deſtroys 200 *l.* of it * which is the ſame *4 it he had ſubtracted 200 *l.* of Poſſitive Eſtate, therefore to add a Negative to an Affirmative is the ſame, as to Subſtract an Affirmative from an Affirmative.

(18.) Again, That to add a Poſitive to a Negative is the ſame as to Subſtract a Negative from a Negative, appears alſo from the Definiti-
4th* on of Poſitive and Negative Quantities, and in the Affairs of Life is thus, Suppoſe a Man to owe 1000 *l.* more than his Affirmative Eſtate is worth, if his Friend pay 500 *l.* of the Debt, it is adding a Poſitive to his Negative Eſtate, which deſtroys 500 *l.* of the Negative. Therefore, *&c.*

CASE III,

(19.) When the Quantities are unlike (that is repreſented by different Letters) *Rule*, Set them down one after another, with their reſpective Signs, Thus

$$\text{add}\begin{cases}+7ab\\-5xy\\+7dc\end{cases}\qquad\qquad \text{add}\begin{cases}-13cd\\+\ 4xyz\\+\ 3ab\end{cases}$$

$$\text{Sum } +7ab-5xy+7dc \qquad \text{Sum}-13cd+4xyz+3a$$

Becauſe different Letters repreſent different Quantities, they cannot be added together any other Way than by placing them one after another, for if $+6a$ be to be added to $5b$, and $6a$ repreſent 600 Men, and $5b$ 500 Horſes, and if the Sum of both were required, it is evident that their Sum will be $+6a+5b$ that is 600 Men and 500 Horſes.

CAS

CASE IV.

ddition of Compound Algebraical Integers.

o.) THE Addition of Compound Quantities may eaſily be performed by e preceeding Rules. Thus,

$$\text{add}\left\{\begin{array}{r}+5ab-17xy+10cd\\+6ab+10xy+5cd\end{array}\right.$$

$$\overline{11ab\;-\;7xy+15cd}$$

$$\begin{array}{r}\text{ain,}\\\text{dd}\end{array}\left\{\begin{array}{r}aa-5a+24\\aa+a-17\\-2aa+2a+12\end{array}\right.$$

$$\overline{0\quad-2a+19}$$

$$\text{add}\left\{\begin{array}{l}x+b\\c-e\\y+x\\b-z+y\end{array}\right.$$

$$\overline{2x+2y+2b+c-e-z}$$

$$\begin{array}{r}\text{gain,}\\\text{add}\end{array}\left\{\begin{array}{r}5x^3-3y^2+10\\4x+2y^2+12a\\10x^3+10z^2+10b\\-12x^3+10y_2-10c\end{array}\right.$$

$$\overline{+7x^3+9y^2+10z^2+10+12a+10b-10c}$$

(21.) It is evident by preceeding Examples, th Compound Quanities are added by the Three fir Caſes of this Section, *viz.* 1*ſt* By adding the Co-e ficients of all thoſe Quantities, which are repre ſented by the ſame Letters, and have the ſam Sign and ſetting down the common Letters, an the common Sign. 2*dly*, Subtracting the Co-effic ents of thoſe Quantities that are repreſented b the ſame Letters, but have different Signs. An 3*dly*, Setting down the unlike Quantities, an joyn them with their proper Signs.

SECT. III.

Subtraction of Algebraick Integers.

CASE I.

(22.) WHen the Quantities given to b Subtracted, are repreſented b the ſame Letters, and have like Signs, ſubtra the leſſer Co-efficient from the greater, and the remainder prefix the common Letters, a the common Sign.

Thus,
From $+16ab-12xy$ $12cd+14xy-10bc$
take $+10ab-8xy$ $4cd+5xy-5bc$

$+6ab-4xy$ $8cd+9xy-5bc$

(23.) The Reaſon of the above Rule is evide becauſe the Sum of the Co-efficients, when Quantities are alike, and have like Signs w the common Letters, and common Sign gi the Sum of the given Qualities *. Theref

*14

e Difference of the Co-efficients when the uantities are like, and have like Signs, with the mmon Letters prefixed, and the common Sign uſt be the Difference of the given Quantities.

CASE III.

When the Quantities given to be ſubtracted, are preſented by the ſame Letters, but have unlike gns.

(24.) *Rule,* Add the Co-efficients, prefix the mmon Letters, with the Sign of the Quan- y, from which the Subtraction is to be made.

Thus,

rom $+16xy$	From $-5abc$	From $+8x^2y^3$
take $-4\,xy$	take $+4abc$	take $-5x\,y^3$
main. $+20xy$	Remains $-9abc$	Remains $13x^2y^3$

(25.) becauſe it has been proved, * that to add *17 Negative to an Affirmative, is the ſame as to btract a Poſitive from a Poſitive; and Sub- ction being the reverſe of Addition, hence will appear that to ſubtract a Negative from Affirmative, is the ſame as to add a Poſitive a Poſitive; and in the Affairs of Life it may proved thus. Suppoſe a Man to have of Poſi- e Eſtate *L.* 10000. and of Negative Eſtate, or bts, *L.* 1000. If his Friend by way of Preſent, Pay *L.* 1000. he takes away, or ſubtracts the Ne- ive Eſtate, and in ſo doing adds *L.* 1000. to Affirmative Eſtate, being his real Eſtate was y *L.* 9000. before the Debt was paid, but af- wards *L.* 10000. therefore to ſubtract a Nega- e from a Poſitive, is the ſame as to add a Poſi- e to a Poſitive.

(26.) Alſo by * the Definition of Poſitive *4 Negative Quantities; it appears that a Poſitive added to a Negative, deſtroys ſo much of a Negative, therefore if a Poſitive be ſubtracted from a Negative, it will encreaſe the Negative.

CASE III.

(27.) When unlike Quantities are given to be ſubtracted. *Rule*, Change the Sign of the Quantities to be ſubtracted, and ſet them down after the Quantities from which the Subtraction is to be made.

Thus,

From	$5x$	$+16ab-5xy$
take	$2a$	$-10cd+mc$
Remain.	$5x-2a$	$16ab-5xy+10cd-mc$

$$
\begin{array}{l}
-5x^3+2a^2b \\
+4x^3+2d^2a \\
\hline
-9x^3+2a^2b-2d^2a
\end{array}
$$

Multiplication of Algebraick Integers.

CASE I.

(28) WHen two Simple Quantities are given to be Multiplied, whether they be like or unlike.

Rule, Join the Letters of both Quantities together, like Letters in a Word, it matters not in what order they are written; the new Quantity repreſented by thoſe Letters ſo ſet together is the Product ſought: And if the Quantities given to be Multiplied have co-eficients. Firſt

Multipl

Multiply the Numbers, and to that Product join the Letters of both Quantities.

Thus,

Multiply	bx	a	c^2
By	cd	b	x^2
Product	$bxcd$	ab	c^2x^2

A General Rule for the Signs.

(29.) Like Signs give $+$, and unlike Signs give $-$ for the Sign of the Product.

That is, when the Quantities given to be multiplied are both Affirmative, or both Negative, the Product will be Affirmative; but if one of the Quantities be Affirmative, and the other Negative, the Product will be Negative.

The preceeding Rule may be thus Demonſtrated.

Since Multiplication is the ſame Thing as adding one Factor to it ſelf, or repeating it ſo often as there are Units in the other.

(30.) Therefore $+$ Multiplying $+$, muſt produce a Poſitive Sum.

(31.) A *Poſitive Multiplying* a *Negative*, muſt produce a Negative, for it is only adding the Negative Factor to it ſelf, ſo often as there are Units in the other. Now many Defects added, will ſtill be Defects, and conſequently will have a Negative Sign.

Thus,

$-3a$ Multiplied by $+2x$, produces $-6ax$

(32.) Negatives multiplying Poſitives, muſt produce Negatives, for when the Multiplicaton is Negative, it muſt work on the Multiplicand

by Subtraction; therefore in this Caſe the Multiplicand muſt be ſubtracted (or made Negative) as often as there are Negative Unites in the Multiplicator; but to take away Poſitives is to
26 * add Negatives *. Therefore the defect of the Multiplicand, is to be added, or repeated as often as the Caſe requires; and if ſo, the Product muſt be Negative: Therefore

$$+5a \times -4a = -20aa.$$

(33.) Negatives multiplying Negatives, muſt produce Poſitives; For ſince Multiplication by a Negative, is the ſame as Subtraction; and ſubtracting a Defect, or Negative the ſame as adding Poſitives, therefore it is clear the Defect of the Multiplicand, muſt be ſubtracted (that is, the Poſitive Multiplicand added) ſo often as there are ſeeming Unites in the Multiplicator, therefore the Sum or Product muſt be Poſitive; Thus,

$$-6a \times -4x = +24ax.$$

Examples.

$$\begin{array}{lccc}
\text{Multiply} & +6ab & -13xy & +4cd \\
\text{by} & +3ab & +3a & -3xy \\
\hline
 & +18aabb & -39axy & -12cdxy
\end{array}$$

$$\begin{array}{lc}
\text{Multiply} & -7xc \\
\text{By} & -4a \\
\hline
 & +28axc
\end{array}$$

(34.) The Products of the ſame Quantity continually Multiplied are called Powers, which are ſaid to be of 2, 3, or 4 Dimenſions, when the

ſaid

l Quantity (then call'd a Root) is repeated
ice, thrice or four times, *&c.* Thus,

x	is called the	1*ſt*	Powers of x	and is briefly expreſſed thus.	x
x		2*d*			x^2
xx		3*d*			x^3
xxx, &c.		4*th*			x^4

he Numbers that are placed above the Let-
or Root towards the right-Hand, are cal-
Indices or Exponents of their Powers; be-
ſe they indicate or expound the Number of
al Factors the Product is made up of. Thus
repreſents the Product of ſix Factors each equal
. or *aaaaaa.*

CASE II.

35.) To Multiply compound Quantities. *Rule,*
ltiply every Part of the Multiplicand, by all the
ts of the Multiplier taken ſeparately, obſer-
the Rule for the Signs, and Co-efficients,
in Caſe 1. Then add theſe Products into
Sum, obſerving the Rules of Addition.

Thus,

Mult. $a+b$	$3a-5b$	Mult. $a+b$
By c	$+4b$	By $a+b$
		$ab+bb$
roduct $ac+bc$	$12ab-20b^2$	$aa+ab$
		Product $aa+2ab+bb$

Mult. $a-b$
By $a-b$

$-ab+b^2$
$aa-ab$

Product $aa-2ab+b^2$

Mult. $3x-4e$
By $4x-2e$

$-6xe+8e^2$
$12x^2-16xe$

Pr. $12x^2-22xe+6e^2$

Mult. $2xa-3yc$
By $3xa+4yc$

$+8xayc-12y^2c^2$
$6x^2a^2-9xayc$

$6x^2a^2-xayc-12y^2c^2$

$x+y$
$x-y$

x^2+xy
$-xy-y^2$

x^2-y^2

Mult. $3a-4x+y$
By $3b-2y$

Product $9ab-12bx+3by-6ay+8xy-2y^2$

Mult. $4x^3+3x^2-2x+4$
By x^2-4x+6

$4x^5+3x^4-2x^3+4x^2$
$-16x^4-12x^3+8x^2-16x$
$+24x^3+18x^2-12x+24$

Product $4x^5-13x^4+10x^3+30x^2-28x+24$

Mult. $yy + 2xy - \frac{1}{2}x^2$
By $yy - 2xy + x^2$

$$
\begin{array}{l}
x^2y^2 + 2x\ y - \frac{1}{2}x^4 \\
-2xy^3 - 4x^2y^2 + x^3y \\
y^4 + 2xy^3 - \frac{1}{2}x^2y^2 \\
\hline
y^4 \quad - 3\frac{1}{2}x^2y^2 + 3x^3y - {}_{2}x^4
\end{array}
$$

Mult. $3x + 4y$
By $2x - 4b$

$$
\begin{array}{l}
6x^2 + 8xy \\
\quad -12xb - 16by \\
\hline
6x^2 + 8xy - 12xb - 16by
\end{array}
$$

.B. *It matters not how the ſeveral Products are placed.*

Diviſion of Algebrarick Integers.

) *Algebraick Diviſion*, doth by two Quantities,
whereof one is called the Dividend, and
other the Diviſor, find out a third called the
tient ; to wit ſuch a Quantity, that if mul-
ied by the Diviſor it will produce the Dividend.
he Nature of Diviſion is to reſolve, or undo
which is compounded or done by Multiplica-
; for the Dividend always repreſents the Pro-
in Multiplication, the Diviſor one of the
ors or Multipliers, and the Quotient the o-
; therefore the general Rule for the Signs
he Product In Multiplication, will likewiſe
good for the Signs of the Quotient in Di-
n, that is, if the Sign of the Diviſor and
dend be both + or both — the Sign of the
tient will be + ; but if one of them be +,
and

and the other — the Sign of the Quotient muſ be —.

CASE I.

(37.) When two Quantities are given to b divided, the Quotient may be repreſented by ſetting the Dividend for a Numerator, and the Diviſor for a Denominator.

Thus,

xa Divided by $yz = \frac{xd}{yz}$

Alſo ba Divided by $x = \frac{ba}{x}$

CASE II.

(38.) When the ſame Letter or Letters, ar found in all the Quantities, both of the Diviſo and Dividend equally repeated, caſt away tho Letters, and the remaining Quantities ſhall ſigni the Quotient.

Thus,

$$\left.\begin{array}{r}\text{Dividend } xa\\ \text{Diviſor } ba\end{array}\right\}\text{Quotient } \frac{x}{b}$$

Alſo $xb-xc$ divided by $xd - xy = \frac{b-c}{d-y}$

And x^2a divided by $ax = a$

CASE

CASE III.

Dividend	$2abd+3bd$	$2baa+caa-3aa$
Diviſor	$3bb-b$	$baaa-daa+aa$
uotient	$\frac{2ad+3d}{3b-1}$	$\frac{2bu+c-3}{ba-d+1}$

(39.) If the Co-efficient of the Diviſor do ually divide all the Co-efficients of the Dilend, the Quotient of that Diviſion will be Co-efficient of the Quotient.

Thus,

ividend	$30xa+15xy$	$48a^2b^2-36a^2x^2$
Diviſor	$5xc$	$6a^2c+$
otient	$\frac{6a+3y}{c}$	$\frac{8b^2-6x^2}{c}$

CASE IV.

Vhen the Dividend is equal to the Diviſor, Quotient is 1; for every Quantity contains it once, and therefore being Divided by it ſelf s 1, or Unity, in the Quotient.

Thus,

$$\left.\begin{array}{l}\text{Divided}\\ \text{by}\end{array}\right\}\begin{array}{l}x^2a-yz\\ x\,a-yz=1\end{array}$$

In each of the preceeding Examples: If th Quotient be Multiplied by the Diviſor, the Product will be epual to the Dividend.

CASE V.

Of the Diviſion of Compound Quantities.

(40.) LET the Terms of the Dividend an Diviſor be ranked according to th Dimenſions of one of their Letters, as in th following Example; where they are ranked a cording to the Dimenſions of x. Then find th Sign of the Quantity to be ſet in the Quotie
38 * by the foregoing General Rule. *.

Secondly, Divide the Co-efficient of the fi Term of the Dividend, by the Co-efficient the firſt Term of the Diviſor, and that Quo ent will be the Co-efficient of the Quantity, be ſet in the Quotient.

Thirdly, Find what Quantity when Multip ed by the firſt Term of the Diviſor, will p duce the firſt Term of the Dividend, and th Quantity joined to the Sign and Co-efficie found as above, will be the Quantity to be in the Quotient.

Fourthly, Multiply the whole Diviſor by t Quantity ſet in the Quotient, and ſubtract t Product from the Dividend, and to the Remain bring down the next Quantity, which annexed it will be a new Dividend.

Fifthly, Again, As in the firſt Step of t Rule, find the Sign of the ſecond Quantity to be ſet in the Quotient, alſo its Co-efficient ſecond Step, and the Quantity it ſelf by the d Step of this Rule, then Multiply the whole iſor by the ſecond Quantity ſet in the Quo- t, and ſubtract that Product from the laſt idend, and after this Manner proceed till have no Remainder.

Examples.

$$\begin{array}{l} y\,)\,x^3+3x^2y+3xy^2+y^3\,(\,x^2+2xy+y^2 \\ x^3+x^2y \\ \hline \qquad 2x^2y+3xy^2 \\ \qquad 2x^2y+2xy^2 \\ \hline \qquad\qquad xy^2+y^3 \\ \qquad\qquad xy^2+y^3 \\ \hline \qquad\qquad\quad 0 \end{array}$$

$$\begin{array}{l} -y^2\,)\,9x^4+12x^3y-4xy^2-y^4\,(\,3x^2+4xy+y^2 \\ 9x^4-3x^2y^2 \\ \hline \qquad 12x^3y+3x^2y^2-4xy^2 \\ \qquad 12x^3y \qquad\quad -4xy^2 \\ \hline \qquad\qquad 3x^2y^2-y^4 \\ \qquad\qquad 3x^2y^2-y^4 \\ \hline \qquad\qquad\quad 0 \end{array}$$

$$a^2-2ab+b^2)\,a^4-4a^3b+6a^2b^2-4ab^3+b^4\,(a^2-2ab+b$$
$$a^4-2a^3b+a^2b^2$$
$$-2a^3b+5a^2b^2-4ab^3$$
$$-2a^3b+4a^2b^2-2ab^3$$
$$+a^2b^2-2ab^3+b^4$$
$$+a^2b^2-2ab^3+b^4$$
$$0$$

Diviſor. Dividend. Quotient.

$$3x-6)\,6x^4-96\,(2x^3+4x^2+8x+16$$
$$6x^4-12x^3$$
$$+12x^3$$
$$+12x^3-24x^2$$
$$+24x^2$$
$$+24x^2-48x$$
$$+48x-96$$
$$48x-96$$
$$0$$

Diviſion is proved by Multiplying the Quotient by the Diviſor, and the Product will be eqnal to the Dividend when the Diviſion is right. Thus, to prove the preceeding Example.

Multiply $2x^3+4x^2+8x+16$
By $3x-6$

$$-12x^3-24x^2-48x-96$$
$$6x^3+12x^3+24x^2+48x$$

Pro. is $6x^4 \text{———} 96$

ifor. Dividend. Quotient.

$$-\tfrac{1}{2}xx\,\big)\,\tfrac{4}{9}xxy^3+\tfrac{13}{12}x^4y-x^5\,\big(\,\tfrac{2}{3}xyy+\tfrac{13}{8}x^3+\tfrac{1}{2}xxy+\tfrac{3}{8}x^3=$$
$$\tfrac{4}{9}xxy^3-\tfrac{1}{3}x^3yy \qquad =\tfrac{2}{3}xyy+\tfrac{1}{2}xxy+2x^3$$

$$\tfrac{13}{12}x^4y+\tfrac{1}{3}x^3yy-x^5$$
$$\tfrac{13}{12}x^4y \qquad -\tfrac{13}{16}x^5$$

$$+\tfrac{1}{3}x^3yy-\tfrac{3}{16}x^5$$
$$+\tfrac{1}{3}x^3yy-\tfrac{1}{4}x^4b$$

$$-\tfrac{3}{16}x^5+\tfrac{1}{4}x^4y$$
$$-\tfrac{3}{16}x^5+\tfrac{1}{4}x^4y$$

$$0$$

41) If *Algebraick Diviſion*, according to this neral Method, will not work off, with- a Remainder; then you may write the Di- end and Diviſor Fractionally or ſometimes Quotient may be expreſs'd partly by Inte- s, and partly by a Fraction; as if $bb+bd+cc$ be be divided by $b+d$, the Quotient may be reſſed either Thus, $\dfrac{bb+bd+cc}{b+d}$ or elſe Thus,

$$b\frac{+cc}{b+d},$$ which latter Quotient is found by the General Rule, for after you have di- vered thereby as many Integers as can ariſe in

in the Quotient, you may ſet the Remainder the Dividend as a Numerator, and the Divi for a Denominator to this Fraction, which tog ther with the ſaid Integer or Integers, ſhall b equal to the Quotient ſought.

SECT. VI.

Reduction of Algebraick Fractions.

ALthough the Doctrine of Fractions in Sp cies is often uſed in the Solution of nalytical Queſtions; yet ſince the Reader of th Appendix, is ſuppoſed to have perfectly lea *the Doctrine of Vulgar Fractions*, Cap. xxiii. of *preceeding Book*, and there is ſo very litt difference betwixt the Method of working Fra tions in Numbers and Species, therefore I ſh not need to enlarge much upon this Section.

CASE I.

(42.) To reduce Mix'd Quantities to Fr ons.

Rule, Multiply the whole Quantity by Denominator of the Fraction, and to that Pr duct add the Numerator, which ſet over Denominator. Thus $3xy\frac{a}{b} = \frac{3bxy+a}{b}$

and $x+y\frac{c-b}{x-y}$ reduced to a Fraction is eq

$$\frac{xx-yy+c-b}{x-y}$$

Alſo $2a-cb\frac{a+b}{2x}$ reduced to a Fraction i

ial to $\frac{4ax-2cbx+a+b}{2x}$

CASE II.

(43,) To reduce Fractions having different nominators, to Fractions of the ſame Value, ich ſhall have a common Denominator.

ule, Multiply all the Denominators toge- r, for a common Denominator; then Mul- ly any one of the Numerators into all the De- minators but its own, and the laſt Product for a new Numerator over the ſaid com- n Denominator. So this Fraction is equal that whoſe Numerator you Multiplied into the Denominators, but its own continually: ſo with the reſt of the Numerators, and u will have your deſire. Thus,

Let it be required to bring $\frac{x}{y}$ and $\frac{a}{b}$ to one nomination.

$b\times y=by$ is the common Denominator.

$\left.\begin{array}{l} x\times b=xb \\ a\times y=ay \end{array}\right\}$ New Numerators therefore $\frac{xb}{by}$ and $\frac{ay}{by}$ are Fractions equal to $\frac{x}{y}$ and $\frac{a}{b}$

Alſo let $\frac{x}{a}$, $\frac{y}{b}$, and $\frac{z}{d}$ be Fractions given, to reduced to others of the ſame Value, having common Denominator.

$a\times b\times d$

$a\times b\times d=abd$ the common Denominator.

$$\left.\begin{array}{l} x\times b\times d=xbd \\ y\times a\times d=yad \\ z\times a\times b=zab \end{array}\right\}\text{New Numerators.}$$

Therefore $\frac{xbd}{abd}$ $\frac{yad}{abd}$ and $\frac{zab}{abd}$ are the Fractions required.

CASE III.

(44.) To abreviate, or bring a Fractional Quantity into its loweſt Denomination.

Rule, Divide the Numerator and Denominator ſeverally by their greateſt common Diviſor and the Reſpective Quotients placed Fractionally is the Fraction required.

N. B. The greateſt common Diviſor may b found by the *6th Rule*, of the xxiii *Chap.* o the preceeding Book.

Let it be required to Reduce $\frac{xxa}{ad}$ to its lea Terms, a being the common Diviſor $xxa\div a=x$ a new Numerator, and $ad\div a=d$ a new Denominator; conſequently $\frac{xx}{d}$ is the Fraction requir

In like manner $a+\frac{bdc}{bc}$ is found to be

$=a+\frac{d}{1}=a+d.$

CASE IV.

(45.) To reduce a Compound Fraction to Simple one of the ſame Value.

Rule, Multiply the Numerators by each oth continually for a new Numerator, and the D nominators continually for a new Denominator will be the new Fraction and that which was r quired.

L

Let it be required to reduce $\frac{4}{5}$ of $\frac{2}{x}$ of $\frac{a}{b}$ to Simple Fraction of the ſame Value, $4\times2\times a=8a$ e new Numerator. $5\times x\times b=5xb$ the new De- minator, conſequently $\frac{8a}{5xb}$ is the Fraction re- ired.

Alſo let it be required to reduce $\frac{x+y}{a}$ of $\frac{2}{c-d}$ $\frac{x}{y}$; $\overline{x+y}\times2\times x=2xx+2xy$ the new Numera- . $a\times\overline{c-d}\times y=acy-ady$ the new Denomina- , conſequently $\frac{2xx+2xy}{acy-ady}$ is the Fraction re- ired.

Let $\frac{3ub+cd}{m}$ of $\frac{r-5st}{b+n}$ be reduced to a Simple action. $\overline{3ub+cd}\times\overline{r-5st}=3bru+cdr-15stub-$ dst a new Numerator. $m\times\overline{b+n}=bm+mn$ a v Denominator, conſequently,

$\frac{u+cdr-15bstu-5cdst}{bm+mn}$ is the Fraction required.

SECT. VII.

ddition and Subtraction of Algebraick Fractions.

WHat hath been done by the Rules in the *Sect.* immediately preceeding is chiefly to pre- e Fractions of different Denominations for *Ad- on* or *Subtraction*, as occaſion requires; *viz.* 46.) If the Fractions given to be added or ſub- cted be compound ones, they muſt be reduced

* 45 to Simple or Pure Fractions *; and if they hav not a common Denominator, they muſt be reduced to Fractions of the ſame Value that wil
* 43 have a common Denominator *; that being don *Addition* and *Subtraction* are thus performed.

(47.) *Rule*, Add or ſubtract their Numerators as occaſion requires; and under their Sum or Difference, ſubſcribe their common Denominator.

Thus,

To add $\frac{xx}{a}$ to $\frac{yy}{a}$ the Sum will be $\frac{xx+yy}{a}$; likewiſe the Sum of $\frac{5a-3b}{c+d}$ and $\frac{2b-3a}{c+d}$ will b found $\frac{2a-b}{c+d}$. So alſo to add $\frac{a}{b}$ $\frac{c}{d}$ and $\frac{2ex}{g}$ th Sum will be found $\frac{adg+cbg+2bdex}{bdg}$

Likewiſe to add theſe three Fractions $\frac{a-b}{a^3-ab}$ $\frac{b^2}{a^2+2ab+b^2}$ and $\frac{a^2-ab}{a^2-b^2}$ they being firſt broug
* 43 to a common Denominator *, and the Sum the Numerators ſet over the common Denomi tor, will ſtand Thus,

$$\frac{a^4+a^2-ab^3-b^2}{a^4+a^3b-a^2b^2-ab^3}$$ the Sum required.

Ex

Examples in Subtraction.

From $\frac{5aa}{a}$ $\frac{7xy}{a-b}$ $\frac{a+b+aa}{d+c}$

take $\frac{3aa}{a}$ $\frac{5zc}{a-b}$ $\frac{a+b}{d+c}$

emain. $\frac{2aa}{a}$ $\frac{7xy-5zc}{a-b}$ $\frac{aa}{d+c}$

Alſo if from $\frac{8aa-7b+6}{a+b}$ it be deſired to ſub-ract $\frac{3aa+12b-18}{a+b}$ the Remainder will be ſound $\frac{aa-19b+24}{a+b}$

SECT. VIII.

ultilpication of Fractional Qantities.

48.) FIrſt prepare mixt Quantities (if there be any to be Multiplied) by reducing hem to Fractions * and whole Quantities, by ibſcribing an Unit under them: Then * 42

(49.) *Rule*, Multiply the Numerators together for a new Numerator, and the Denomiators together for a new Denominator; then his new Fraction is the Product required.

Thus,

Multiply $\frac{xy}{a}$ $\frac{3x-2a}{2d+c}$

By $\frac{xb}{d}$ $\frac{4x+2a}{d}$

Product $\frac{x^2yb}{da}$ $\frac{12xx-2xa-4aa}{2dd+dc}$

Alſo if $c+b\frac{bb}{d}$ be Multiplied by $a+\frac{ad}{c-d}$ (bein
* 42 firſt reduced * to Fractions) the Product wil
be $\frac{accd+acbb}{dc-dd}$

SECT. IX.

Diviſion of Fractional Quantities.

THE Fractional Quantities being prepare as directed in the laſt *Section*, Then

(51.) *Rule*, Multiply the Numerator of th Dividend, by the Denominator of the Diviſo for a new Numerator, and Multiply the Denomi nator of the Dividend, by the Numerator of th Diviſor, for a new Denominator; and this ne Fraction will be the Quotient required.

Thus,

Diviſor	Dividend.	Quotient.
$\frac{x}{y}$)	$\frac{x+y}{a-b}$	($\frac{xy+yy}{xa-xb}$

Diviſ

Diviſor.	Dividend	Quotient.
$-\frac{x+y}{a-b}\Big)$	$\frac{a+b}{x-y}$	$\Big(\frac{aa-bb}{xx-yy}$

N. B. *This Operation is the ſame with Multiplica-n, if you invert the Order of the Diviſor before you in.*

SECT X.

Of the Involution of Powers.

.) INvolution, is the raiſing or producing of Powers, from any propoſed Root; l is performed in all Reſpects like Multiplica-n; ſave only in this, Multiplication admits any different Factors, but Involution ſtill ains the ſame: And Products made by the tinual Multiplication of the ſame Quantity or ctors are *Poſitive Powers*; but the Quotients of Unit divided by any Power of the ſame antity, are Negat ive Powers,

Thus,

, x^2, x^3, x^4, &c. are Poſitive Powers of x;

$\frac{1}{x}$, $\frac{1}{x^2}$, $\frac{1}{x^3}$, $\frac{1}{x^4}$, &c, are Negative Powers x, and are to be expreiſed Thus, x^{-1}, x^{-2}, , x^{-4}, &c. with Negative Exponents.

(53.) Suppoſing that any Root is the firſt wer of it ſelf; or that the firſt Power ariſes en the Root is Multiplied into Unity. If then ſame Root be Multiplied into it ſelf it pro-es its Square or ſecond Power, and if the ot be Multiplied into its Square it will pro-e its Cube or third Power, and the Root Mul-yed into its Cube produces the Biquadrate fourth Power, *&c.* The Exponents of thoſe

Powers are 1, 2, 3, 4, 5, according to t Number of Dimenſions of which they are co pounded, or univerſally, the Exponents may repreſented by Letters, x, x^2, x^3, x^4, $=x$, x x^n, &c.

(54.) Powers, are not only produced from t Root it ſelf, Multiplied into the Degree n going before, but alſo from the mutual Multip cation of the inferior Powers, as their very Na declare, for Example, The Biquadrate ariſes only from the Root multiplied into the Cu but alſo from the Square multiplied into it ſe whence this Power (*i. e.* the fourth) is alſo Square, and the like you may judge of the r Every Root is either (1.) Simple, that is of Name, as a, $2a$, or $3a$, &c. for the Number before the Letters do not increaſe the Na or (2) compound or of more Names, that is, nomials, Trinomials &c. as $a+x$ or $x-$ $x+y+z$, $x-y+z$, $x+y-z$, $x-y-z$.

(55.) Moreover every Root is either rati as x, $2x$, $\frac{1}{2}x$. &c. or Irrational as $\sqrt{x}$, $\sqrt{xa}$, and as the Roots are, ſuch alſo are their wers; but in this Place we ſhall treat only thoſe that are rational.

(56.) The Geneſis of Powers from a Simple R are thus performed; if the Root be a Side firſt Power) let there be annexed to it a Si Number or Letter, ſuch as agrees to the ture of that Power, and placed above to right-Hand as the Index of the Multiplicati As if the Root be x, its Square will be x^2, C x^3, &c.

(57.) If the Root have a Co-efficient, to be raiſed with the Root to the Power req

T

Thus,
Let the Root be $3xy$
ts Square is, $9x^2y^2$
ts Cube $27x^3y^3$
ts Biquadrate
or fourth Power. $\Big\}\ 81x^4y^4$

(58.) Any Powers (of the ſame Quantity) whe-
r Poſitive or Negative, are Multiplied into
another by the Addition of the Exponents.

Thus,
$x^5=x^8$; $a^4\times a^2=a^6$ $x^{\frac{3}{2}}\times x^{\frac{5}{2}}=x^{\frac{8}{2}}=x^4$
$x^{-2}\times x^{-3}=x^{-5}$; $a^{-1}\times a^{-2}=a^{-3}$

(59.) The Diviſion of Powers is done by the
btraction of the Exponents.

Thus,
$x^7\div x^5=x^2$; $a^8\div a^3=a^5$

$x^{-6}\div x^{-4}=x^{-2}$

(60.) The Raiſing of Powers to other
wers, is done by Multiplying the Exponents.
Thus, If any given Power is to be raiſed to
other given Power, the Index of the Power
poſed, muſt be multiplied into the Index of
t Power, to which the firſt ought to be raiſed.
x^5 raiſed to the third Power, is $x^5\times{}^3=x^{15}$.

The Involution of any Binominal or Quan-
, conſiſting only of two Terms, as $x+y$ may
performed by the two following Rules, the
t of which diſcovers the Indices of the Pow-
required, and the other the Co-efficients.

(61.) *Rule*, 1. When any Binominal, as $x+y$ is to be raiſed to any Power, as *m*, the Quanti- ties that compoſe that Power, will be x^m, $x^{m-1}y$ $x^{m-2}y^2$, $x^{m-3}y^3$, $x^{m-4}y^4$, &c. continuing this Series till the Exponent of *y* becomes equal to *m*, in which Series you ſee the Exponent of of *x* is diminiſhed always by Unite in every Term, from what it was in the preceeding Term, while the Exponent of *y* is conſtantly encreaſed by Unit, above what it was in the preceeding Term. Thus let $m=7$, that is, let $x+y$ be raiſ- ed to the 7*th* Power, and the Quantities that compoſe that Power, will by the preceeding *Rul* ſtand Thus,

$$x^7+x^6y+x+y^2+x^4y^3+x^3y^4+x^2y^5+xy^6+y^7$$

(62.) In which the Indices of the Powers to the leading Quantity *x*, continually decreaſe and the Indices of the other Quantity do con- tinually increaſe in an Arithmetical Progreſſion Unit being their common Difference. The firſt and laſt Terms are always pure Powers of the Single Quantities, and are both of the ſame height. The Sum of the Indices of any two Letters joined together in the intermediate Terms are always equal to the Power required.

(63.) *Rule* 2*d*, The Co-efficient of the firſt Term is always Unite, the Co-efficient of the 2*d* Term, is = to Unite, multiplied into the Index of the Power of the firſt Term, and that Product di- vided by Unite: The Co-efficient of the third Term, is found by multiplying the Co-efficient of the ſecond Term, into the Index of the lead- ing Quantity of that Term, and that Product divided by two; ſo the Co-efficient of any Term may be found by multiplying the Index of the leading Quantity of the preceeding Term, by

Co-effici

o-efficient and dividing that Product by the umber of Terms, preceeding the Term whoſe o-efficient is required. Thus to find the Co-ficients of the ſeveral Terms of the *7th* Power $x+y$.

The Co-efficient of the firſt Term is $=1$
The Co-efficient of the ſecond Term is $\frac{1\times7}{1}=7$
of the third Term is $7\times6\div2=21$
of the fourth Term is $21\times5\div3=35$
of the fifth Term is $35\times4\div4=35$
of the ſixth Term is $35\times3\div5=21$
of the ſeventh Term is $21\times2\div6=7$
he Co-efficient of the laſt Term is $7\times1\div7=1$

d if thoſe Co-efficients be prefixed to the Quan-ies that make up the ſeveral Terms of the *7th* ower they will ſtand thus, $x^7+7x^6y+21x^5y^2+$ $5x^4y^3+35x^3y^4+21x^2y^5+7xy^6+y^7$.

(64.) Now here it may be further obſerved, at the *Unciæ* (or Co-efficients) do only encreaſe til the Indices of the two Letters become equal, change Places; and the reſt of the *Unciæ* ll return, or decreaſe in the ſame Order. That where-ever the Indices of the Letters are a-e, there the *Unciæ* will be alike.

And therefore one needs to find the *Unciæ* before) but to half the Number of Terms any Power.

(65.) The two preceeding Rules may be Uni-rſally applied, Thus, If *m* be equal to any hole Number; then the ſeveral Terms of the h Power of $x+y$ will be equal to $x^m+mx^{m-1}y$ $+m\times\frac{m-1}{2}x^{m-2}y^2+m\times\frac{m-1}{2}\times\frac{m-2}{3}x^{m-3}y^3+m\times$ $1\times\frac{m-2}{3}\times\frac{m-3}{4}x^{m-4}y^4+$, &c.

(66.) The Powers raiſed from a Reſidual Root, *viz.* $x-y$ (the Difference of two Quantities) are the ſame with their like Powers raiſed from a Binomial Root $x+y$ (or the Sum of two Quantities) ſave only in their Signs, *viz.* The Binomial Powers have the Sign + to every Term; but the Reſidual Powers have the Sign + and — interchangeably to every other Term.

(67.) Fractions are involved by Multiplying the Numerator into it ſelf, for a new Numerator, and the Denominator into it ſelf, for a new Denominator; each ſo often as the Power requires.

Thus the third Power of $\frac{x}{y} = \frac{x^3}{y^3}$

The third Power of $\frac{3xa}{2yb} = \frac{27x^3a^3}{8y^3b^3}$

The 3*d* Power of $\frac{x+y}{a-b} = \frac{x^3+3x^2y+3xy^2+y^3}{a^3-3a^2b+3ab^2-b^3}$

SECT. XI.

Of the Evolution of Powers.

Evolution, is the Extracting of Roots from any given Power, being the Reverſe of Involution; and in ſingle Quantities it is eaſie, if the given Power have ſuch a Root as is required, which may be thus known.

(67.) If the given Power have no Number prefixed to it, and its Index can be divided by the Number denominating the Root required, the

Quotien

Quotient will be the Index of the Root ſought, Thus if the Cube Root of a^6 were required, the Number that denominates the Cube Root is 3, therefore $6 \div 3 = 2$ that is $\sqrt{x^6} = x^2$ the Root required, alſo the Cube Root of $x^9 = x^3$.

(68.) If the given Powers have Co-efficients, *viz.* Numbers prefixed to them; then you muſt extract their reſpective Roots.

Thus, The Cube Root of $27x^6 = 3x^2$ and the Square Root of $81x^6 = 9x^3$.

(69.) But if the Root required cannot truly be extracted out of both the Co-efficients and Indices of the given Power, then it is a Surd, and muſt have the Sign of the Root required prefixed to it.

(70.) The Extracting the Roots of Powers repreſented by Numbers, may be performed by the following General Rule.

If the Root required be a Square Root, every ſecond Place is to be pointed, beginning from the Place of Units; if a Cubick, every third Figure; if that of a 4*th* Power, every 4*th* Place, *&c.* and then ſuch a Figure is to be writ in the Quotient, whoſe Square (if the Square Root be required, or whoſe Cube, if it be a Cubick Power, *&c.*) ſhall either be equal to the Figure, or Figures before the firſt Point, or next leſs under them; and then having ſubtracted that Power, the next Figure of the Root will be found by dividing the Remainder, augmented by the next Figure of the Reſolvend, by the next leaſt Power of the Quotient, Multiplied by the Index of the Power whoſe Root is to be extracted, that is, by the triple Square, if the Root be a Cubick one, *&c.* and having ſubtracted the Power of the whole Quotient from the two firſt Periods of the Reſolvend; the third Figure of the Root will be found by dividing the Remainder augmented by the next Figure of the Reſolvend, by the next leaſt Power of the whole Quotient, multiplyed by the Index of the Power to be extracted. Thus,

Let it be required to extract the Cube Root of

99252847(4

The Cube of 4 ſubtract =64 } (6 Quot. of 352÷48. The Remainder with 2 annexed or brought down.
4×=16 16×3=Div.48) 352

The firſt two Periods of the Reſolvend. } =99252

The Cube of 46 ſubtract } =97336 } (3 Quot. Remainder with 8 brought down.
46×46=2126×3=Div.6378) 19168

The whole Reſolvend brought down is } =99252847
The Cube of 463 is = 99252847

Remains 0

Therefore the Cube Root of 99252847 is 463, the three Quotients joined together.

If the Cube Root of 11119431168 be extract-
by the preceeding General Rule, the Work
ll appear thus,

11119431168(2 Quot.
he Cube of 2 Subtract 8
2=4×3= Div. =12) 31 (2 Quot. Remainder with 1 brought down.

The two first Periods of the Reſolvend. 11119
The Cube of 22 Subtract 10648 (3 Quot.
×22=484×3= Quot.=1452)4714 Remainder with 4.

he three firſt Periods of the Reſolvend brought down. 11119431
he Cube of 223 Subtract 11089567
×223=49729×3= iv.149187 298641 (2 Quot. Remainder with 1 brought down.

he whole Reſolvend brought down is 11119431168
he Cube of 2232 is 11119431168

Remains 0

he four Quotients joined together make
2 the Cube Root required.

If the Square Root of 2285126809 be extracted it will be found, 47803 by the preceden General Rule.

Thus,

2285126809(4 Quo

The Square of 4 Subtract 16

4×2=8= Div. =8) 68 (7 Quot.
the Remainde
with 8 broug
down.

The firſt two Periods of the Reſolvend 2285
The Square of 47 Sub. 2209

47×2= Div. =94) 761 (8 Quot.
The Remain-
der with 1
brought down

The three firſt Periods of the Reſolvend 228512
The Square of 478 Sub. 228484

478×2= Div. =956) 286 (0 Quot.
Remainder
with 6.

The four firſt Periods of the Reſolvend 22851268
The Square of 4780 Sub. 22848400

4780×2= Div. =9560) 28680 (3 Quot.
Remaind
with 0 a
nexed.

The whole Reſolvend is 2285126809
The Square of 47803 Subtract 2285126809

Remains 0

The five Quotients joined together make 803 the Root required.

Let the Number 976543210123 be given, and Square Root required.

976543210123 (9 Quot.
The Square of 9 Sub. 81

9×2= Div. =18) 166 (8 Quot. Remainder with 6 annexed.

The first two Periods of the Reſolvend 9765
The Square of 98 Sub. 9604

98×2= Div. =196) 1614 (8 Quot. Remainder with 4 annexed.

The three firſt Periods of the Reſolvend. 976543
The Square of 988 Subtract 976144

988×2= Div. =1976) 3992 (2 Quot. Remainder 2 annexed.

The four firſt Periods of the Reſolvend. } 97654321
The Square of 9882 Sub. 97653924

9882 ÷×2=Div.=19764) 3970 } (0 Quot. Remainder with 0 annexed

The five firſt Periods of the Reſolvend. } 9765432101
The Square of 98820 Sub. 9765392400

98820×2=Div.=197640) 00397012 } (2 Quot. Remainder with 2 annexed.

The whole Reſolvend brought down } 976543210123
The Square of 988202 Sub. 976543192804

Remainder =17319

The ſix Quotients joined together, mak 988202 for the Root, but the Number give being a Surd, there remains 17319 to which i Cyphers be added, the decimal Part of the Roo may be found pretty near by proceeding as above.

A
TABLE
OF
Simple POWERS.

Roots	Squares	Cubes	4*th*, Pow-ers.	5*th* Pow-ers.	6*th* Pow-ers.	7*th* Powers.
1	1	1	1	1	1	1
2	4	8	16	32	64	128
3	9	27	81	242	729	2187
4	16	64	256	1024	4096	16384
5	25	125	625	3125	15625	78125
6	36	216	1296	7776	46656	279936
7	49	329	2401	16807	117649	823543
8	64	512	4096	32768	262144	2097152
9	81	729	6561	69049	621441	5592969

Examples of Extracting the Root of the 5th *Power.*

LET 550731776 be a given Number, whoſe Sur-ſolid Root is required.

Pointed according to the Power 550731776(5 Qt
The 5*th* Power of 5 Subtract 3125

The 4*th* Power of 5 is 625×5=Div.3125 } 24823 } (6 Quot. Remainder with 3annexed

The Reſolvend brought down 550731776
The 5*th* Power of 56 Subtracted 550731776

Remains 0

The two Quotients joined together, make
the Root required.

Alſo let 184528125 be a given Number, who
Sur-ſolid Root is required.

Pointed according to the Power. } 184528125) (4 Q
The 5*th* Power of 4 Sub. 1024 5 Q

The 4*th* Power of 4 is 256×5=Div.1280) 8212) Remainder with annexed.

The Reſolvend brought down 184528125
The 5*th* Power of 45 Subtracted 184528125

Remains 0

The two Quotients joined together make
the Root required.

(80.) The Extraction of Roots out of Sim *Algebraick* Quantities, is evident even from No tion it ſelf; as that $\sqrt{aa}$ is a, and that $\sqrt{xxcc}$ is that $\sqrt{9xxyy}$ is $3xy$, and that $\sqrt{49x^4a^2}=7x^2a$.

ſay theſe are evident, becauſe it will appear at firſt ſight, that the propoſed Quantities are produced by Multiplying the Roots into themſelves. But when Quantities conſiſt of ſeveral Terms, the Work is performed as in Numbers : Thus to extract the Square Root of $xx+2xy+yy$, in the firſt Place write the Root of the firſt Term, xx, *viz.* x in the Quotient, and having ſubtracted its Square xx, there will remain $2xy+yy$ to find the Remainder of the Root by. Say, therefore, how many times is the Double of the Quotient, x found in the firſt Term of the Remainder $2xy$.

$$\begin{array}{lll} xx+2xy+y^2 & & x+y \\ xx & & \\ \hline 2xy+yy & & \\ 2xy+yy & & \\ \hline 0 \quad 0 & & \end{array}$$

I Anſwer, y times, therefore write y in the Quotient, and having ſubtracted the Product of into $2x+y^2$, there will remain nothing, which ews the Work is finiſhed, the Root coming ut $x+y$.

(81.) And thus to extract the Square Root $a^4+6a^3b+5a^2bb-12ab^3+4b^4$ firſt ſet down the Quotient the Root of the firſt a^4, *viz.* , and having ſubtracted its Square a^4 there ill remain $6a^3b+5aabb-12ab^3+4b^4$; to find the emainder of the Root, ſay how many times is a contained in $6a^3b$? Anſwer $+3ab$ which ſet the Quotient, as alſo in the Diviſor, then ultiplying all the Diviſor by the Quantity laſt in the Quotient, *viz.* $3ab$, the Product is $^3b+9aabb$, which being ſubtracted, there will yet main $-4aabb-12ab^3+4b^4$. Therefore double e Quotient for a new Diviſor, and ſee how oft e firſt Term of the Diviſor is contained in the ſt Term of the Remainder, and it is found $2bb$ times, which Quantity ſet in the Quotient alſo in the Diviſor. *laſtly*, Multiply the Diviſor by the laſt Quantity ſet in the Quotient, that Product ſubtract from the laſt Remainder, and nothing remains, whence it follows, that the Root is $aa+3ab-2bb$.

$$a^4+6a^3b+5aabb-12ab^3+4b^4\,\big(\,\text{Quotient, } aa+3ab-2bb$$
$$a^4$$

Diviſor $2aa+4ab-$ $\big)\; 6a^3b+5aabb-12ab^3+4b^4$
$9a^3b+3aabb$

new Diviſor $2aa+6ab-2bb$ $\big)\; -4aabb-12ab^3+4b^4$
$-4aabb-12ab^3+4b^4$

$$0 \qquad 0 \qquad 0$$

If you would extract the Cube Root of $a^3+3aab+3abb+b^3$ the Operation is performed

Thus,

$$a^3+3aab+3abb+b^3\,(a+b$$
$$a^3$$

$3aa)+3aab$ $(b$ Quotient

$a^3+3aab+3abb+b^3$ the Cube of $a+b$

(82.) Extract the Cube Root of the firſt Term and ſet it in the Quotient, then ſubtracting its Cube, ſay, how many times is its triple Square or $3aa$ contained in the next Term of the Remainder $3aab$: And there comes out b, wherefore write b in the Quotient, and ſubtracting the Cube of the Quotient, there will remain therefore $a+b$ is the Root, after the ſame manner, if the Cube Root is to be extracted out o

z^6+

$-2z^5-40z^3+96z-64$ it will come out $zz-4$. And ſo in higher Roots.

SECT. XII.

Of Equations.

.) E*Quations*, which are either two ranks of Quantities equal to one another, one rank taken equal to nothing, are to be ſidered, chiefly after two ways; either as laſt Concluſions to which you come in the olution of Problems; or as Means, by the whereof you are to obtain other final E- tions.

84.) The Solution of a Problem is the An- rof a Queſtion or the Determination of the ntities ſought.

85.) Problems are either determined or inde- nined; determined Problems are thoſe which e a determined Number of Solutions, and in- rmined thoſe which have innumerable Solu- s; and to know whether an Equation be li- ed. Obſerve,

86.) If the Number of Quantities ſought, eed the Number of the given Equations, the eſtion is, capable of innumerable Anſwers; if the Number of the given Equations (not ending upon one another) are juſt ſo many he Number of the Quantities ſought, then he Queſtion truly limited.

(87.) An Equation is two fold, *viz.* 1*ſt* Pure Simple, or 2*d* adfected or compounded.

(88.) A Pure or Simple Equation is th
wherein the Quantity ſought is expreſt by o
Power only, and admits but only of one Sol
tion.

Thus,

$5x+bd=a-4x$, and $7x-bd=c+4x$ a
Simple Equations, where x is the unkno
Quantity.

(89.) An Affected or Compound Equatio
is that in which there are two or more differe
Degrees or Powers, of the Quantities ſough
as in the following Equations, in which x d
notes the Quantity ſought, according to wh
Dimenſions the Terms as you ſee are order
(or ranged) and a, b, c, d, denote any oth
Quantities from which, being known and dete
mined, x is alſo determined, and may be inveſ
gated as hereafter is to be explained.

$$xx+ax=b$$
$$x^3+3ax^2-cx=d$$
$$x^4-ax^3+bx^2-cx=e,$$
&c.

(90.) After this Manner, thereſore the Term
of Equations are to be reduced, according to t
Dimenſions of the unknown Quantity, ſo th
thoſe may be in the firſt Place, in which t
unknown Quantity is of the higheſt Dimenſio
and thoſe in the ſecond Place, in which (x)
of the next greateſt Dimenſion, and ſo on, Th
$x^3+5x^2-4x=120$ is an Equation of the thi
Degree, and $x^4-ax+bx=c$, is an Equation
the fourth Degree, for the Degree of an Equ
tion is always eſtimated by the greateſt Dime
ſion of the unknown Quantity.

(91.)

(91.) By the Rules delivered in the following
tion, determined *Problems*, are reduced to one
uation, which hath only one unknown Quan-
y in it, and is called a Simple Equation.

(92.) In this Simple Equation the unknown
antity muſt be ſo ſeparated from the known,
to ſtand by it ſelf, on one Side of the
uation, or on one Side of the Sign of E-
lity, and all the known Quantities on the
er. This in Equations of one Dimenſion, is
led Reduction of Equations; and in other
ſes, the Solution of the Equations.

SECT. XIII.

the Rules by which Problems *are Solved.*

.) THE Reduction of an Equation is
the ſeparating of one Quantity from
reſt, ſo that it alone ſhall be found on one
e, in which Caſe the Value of it expreſſed
other Quantities, is neceſſarily contained on
other Side of the Equation.

(94.) It is to be obſerved, that the Equality
ot deſtroyed, if all the Members are Mul-
ied, or Divided by the ſame Quantity, nor
he ſame Quantity is added to or ſubtracted from
h; whence it follows, that any Quantity
y be tranſpoſed from one Side to another,
changing its Sign.

RULE I.

RVLE I.

(95.) When there is an intermixture of Qua tities known and unknown, in any Equatio let all the unknown Quantities (by tranſpoſitio be made to poſſeſs only one Side of the Eq ſion, and all the known ones another.

(96.) Tranſpoſition is always done, by c rying the Quantity to be tranſpoſed to the ther Side of the Sign of Equality, with a co trary Sign, to what it had before.

Thus,
Suppoſe $2x+10=x+25$
then $2x-x=25-10$
and $x=15$

Alſo Suppoſe $4x-5=3x+15$
then $4x-3x=15+5$
and $x=20$

RVLE II.

(97.) When the unknown Quantity, is Multip (*viz.* joined) with any that is known; let whole Equation be divided by the known Qu tity, that ſo the unknown may ſtand by it

Thus,
$5x-10=14-x$ alſo if $10x-20=15$
then (by 96,) $5x+x=14+10$ $10x-8x=20$
that is $6x=24$ $2x=35$
then (by 97,) $x=\frac{24}{6}=4$ $x=\frac{35}{2}=17\frac{1}{2}$

RVLE

RULE III.

(98.) If the Quantity whoſe Value is required, be a Fraction, the whole Equation uſt be Multiplied by its Denominator, which ay alſo be applied to any Number of Fracions:

Thus,

$$\frac{5x}{7}+10=20-x$$

then by (98) $5x+70=140-7x$
and by (96) $5x+7x=140-70$
that is $12x=70$
hich by (97) is $x=\frac{70}{12}=5\frac{5}{6}$

lſo ſuppoſe $\frac{4x}{3}-10=\frac{5x}{6}+4$

$$\text{y (98, 96)}\begin{cases}4x-30=\frac{15x}{6}+12\\24x-15x=72+180\\9x=252\end{cases}$$

by (97) $x=\frac{252}{9}=28$

RULE IV.

(99.) When any Quantity (either known or known) is in every Term of an Equation if the ole Equation be divided by that Quantity, Equation will be reduced to lower Terms; theſe,

Suppoſe $bx+bc=bcd$
then by (99) $x+c=cd$
that is by (96) $x=cd-c$

Alſo ſuppoſe $5x^2-15x=20x$
then by (99) $5x-15=20$
that is by (96) $5x=20+15=35$
And by (97) $x=\frac{35}{5}=7$

RULE V.

(100.) If the Quantity whoſe Value is requirec be involved with the Radical Sign, this is firſt t be taken away, by ſeparating according to th preceeding Rules, the Quantity thus involve from the Reſt, ſo that it may be alone on on Side of the Equation, and that Side of the Equation, which is not affected with the Surd Roo muſt be once Multiplied into it ſelf, if th Root be a Square one, or twice if the Ro be a Cubick one, *&c.* and then take away the Radical Sign, and the Equality will ſtill remai as in the following Examples.

Suppoſe $\sqrt{x-4}=12$
then by 100, $x-4=12\times12=144$
and by 96, $x=144+4=148$

Alſo ſuppoſe $\sqrt{\frac{4x}{3}+4}-14=100$

then by (96) $\sqrt{\frac{4x}{3}+4}=100+14=114$

and by (100) $\frac{4x}{3}+4=114\times114=12996$

And by (98) and 96, and 97 $\left\{\begin{array}{l} 4x+12=38988 \\ x=\frac{38988-12}{4}=9744 \end{array}\right.$

If $\sqrt{x}=b+d$
then by (100) $x=\overline{b+d}\times\overline{b+d}=b^2+2bd+dd$

And if $\sqrt[4]{x}=5$
by (100.) $x=625$ equal to the fourth Power of 5

RULE VI.

(101.) If the Side of the Equation which contains the unknown Quantity, be a compleat Square or Cube, then Extract the Square or Cube Root, of both Sides of the Equation, and the Equation ſhall be reduced to one of a lower Degree.

Thus,

$x^2+6=150$
then by (96) $x^2=144$
and by (102) $x=\sqrt{144}=12$

And if $x^3=ac+ad$
by (101) $x=\sqrt[3]{ac+ad}$

RULE VII.

(102.) A Proportion may be turned into an Equation, by making the Product of the Extreams, equal to the Product of the Means.

Thus,

If $4 : 20 :: 6 : x$ Alſo let $b+c : b :: b : x$

then by (102) $4x=120$ $bx+cx=bb$

and by (97) $x=\frac{120}{4}=30$ $x=\frac{bb}{b+c}$

And if $5b+2c : c+b :: c+b : x$

then by (102) $5xb+2xc=cc+2cb+bb$

and by (97) $x=\frac{cc+2cb+bb}{5b+2c}$

RULE VIII.

(103.) If ſome Power of the unknown Quantity, be affected with the Radical Sign, then the Root of this Power is to be extracted from both Sides of the Equation. The unknown Quantity being firſt made to poſſeſs wholly one Side of the Equation, as in the following Example.

$$a+\frac{\sqrt{axx+bxx+d^3}}{\sqrt{c}}=b \text{ Data.}$$

By (96) $\frac{\sqrt{axx+bxx+d^3}}{\sqrt{c}}=b-a$

By (100) $\frac{axx+bxx+d^3}{c}=bb-2ab+aa$

By (98) $axx+bxx+d^3=cbb-2cab+caa$

By (96) $axx+bxx=cbb-2cab+caa-d^3$

By (97) $x^2=\frac{bb-2cab+caa-d^3}{a+b}$

By (103) $x=\frac{\sqrt{cbb-2cab+caa-d^3}}{\sqrt{a+b}}$

RULE IX.

f the Reduction of ſeveral Equations to one.

(102) TWO Equations are reduced to one, by taking away one Quantity; which s done by ſeperating that Quantity. So in one quation, by the preceding Rules, that it may e found alone in one Member, and then ſubſtituting its Value in the other Equation.

Let there be two Equations.

$$\left.\begin{array}{l} ax+dy=fg \\ afx+ddx=aay \end{array}\right\}$$ required x and y

y(96,97) $y=\frac{fg-ax}{d}$

This

The following Equation ariſeth by ſubſtituting in the ſecond Equation, for *y* its Value.

$$\frac{fg-ax}{d}$$

$$afx+ddx=\frac{aafg-a^3x}{d}$$

By (98) $afdx+dddx=aafg-a^3x$

By (96) $afdx+a^3x+dddx=aafg$

By (97) $x=\frac{aafg}{afd+a^3+ddd}$

Let the following be two Equations in which *x* and *y* are required, *viz.*

$$\left.\begin{array}{l} ax+ay=cb-cy \\ ax+cx=ddy \end{array}\right\}\textit{Data.}$$

By (96) $\left\{\begin{array}{l} ax+ay+cy=cb \\ ay+cy=cb-ax \end{array}\right.$

By (97) $y=\frac{cb-ax}{a+c}$

Then in the ſecond Equation, inſtead of *y* ſubſtitute its Value, and this Equation will ariſe.

By (104) $ax+cx=\frac{ddcb-ddax}{a+c}$

then by (98) $aax+acx+cax+ccx=ddcb-ddax$

By (96) $aax+acx+cax+ccx+ddax=ddcb$

By (97) $x = \dfrac{ddcb}{aa+cc+2ac+dda}$

RULE X.

(105.) In two Equations a Quantity may alſo e taken away by finding its Value in each Equation by the preceding Rules; and if thoſe Values be not of the ſame Degree (or Power) aiſe the loweſt Power to that of the higheſt; nd then by making one of thoſe Values equal o the other.

Thus,

$$\left.\begin{array}{l} x+y=a \\ x-y=b \end{array}\right\} \textit{Data.}$$

---

y(96) $\left\{\begin{array}{l} x=a-y \\ x=b+y \end{array}\right\}$

hen will $\left\{\begin{array}{l} b+y=a-y \\ y+y=a-b \end{array}\right\}$ becauſe Things equal
105.by96) to 1 third are equal.

that is $2y=a-b$

By (97) $y=\dfrac{a-b}{2}$

Alſo let $\left.\begin{array}{l} a+x=b+y \\ 2x+y=3b-4x \end{array}\right\} \textit{Data.}$

By (96) $\left\{\begin{array}{l} y=a+x-b \\ y=3b-4x-2x \end{array}\right.$

y (105) $a+x-b=3b-6x$

$$a+7x=4b$$

$$(96)\quad 7x=4b-a$$

$$(97)\quad x=\frac{4b-a}{7}$$

RULE XI.

(106.) When there are given many Equations in each of which there are unknown Quantities one Quantity may be taken away by *Rule* ix or x. and the Number of Equations will the be diminiſhed by Unity.

By *Rule* ix. Seeking the Value of the Quan-tity to be exterminated in one Equation, an ſubſtituting that Value inſtead of that Quantit in the other Equations.

Or by *Rule* x. Seeking the Value of the ſam Quantity in all the Equations in which it is found and comparing thoſe Values together. Thus b diminiſhing continually the remaining Equation by this Method; we ſhall at laſt come to on Equation, wherein there will be but one unknow Quantity.

Thus,

$$\left.\begin{array}{l} x+y+z=a \\ x+y+u=b \\ x+z+u=c \\ x+z+u=d \end{array}\right\} \textit{Data.}$$

By (96) $x=a-y-z$

Then for x in the ſecond and third Equation ſubſtitute its Value.

$$\left.\begin{array}{l} a-y-z+y+u=b \\ z+u+a-y-z=c \end{array}\right\}$$ and theſe will ariſe.

thas is $\left\{\begin{array}{l} a-z+u=b \\ u+a-y=c \end{array}\right.$
the 4th Eq. $y+z+u=d$
$\left.\right\}$ the *Data* brought to three Equations.

Then by $z=a+u-b$

Then inſtead of z in the third Equation of
e laſt *Data*, ſubſtitute its Value.

And it is $=$ to $y+u+a+u-b=d$
that is $=2u+y+a-b=d$
d the 2*d* of e laſt *Data* is $\left.\right\}$ $a-y+u=c$
$\left.\right\}$ the *Data* brought to 1 Equtia-on.

then by (96) $\left\{\begin{array}{l} y=d+b-2u-a \\ y=a+u-c \end{array}\right.$

therefore $d+b-2u-a=a+u-c$ $\left.\right\}$ the *Data* brought 2 Equations.

then by 96, $d+b-2a+c==3u$

and by 97, $u=\dfrac{d+b-2a+c}{3}$

We ſhall here add the Application of the
ond Method of the 10*th Rule* to another Ex-
ple.

$$\textit{Data}\left\{\begin{array}{l} x-y-z=a\\ x-y-u=b\\ x-z-u=e\\ y-z-u=d\end{array}\right.\left|\begin{array}{l} x=a+y+z\\ x=b+y+u\\ x=c+z+u\\ \\ \end{array}\right\}\text{by (96)}$$

$$\begin{array}{l}\text{the }\textit{Data}\\ \text{brought}\\ \text{to 3 Equa.}\end{array}\left\{\begin{array}{l} a+z=b+u\\ a+y=c+u\\ y-z-u=d\end{array}\right.\left|\begin{array}{l} z=b+u-a\\ \\ z=y-u-d\end{array}\right.$$

$$\begin{array}{l}\text{the }\textit{Data}\\ \text{brought}\\ \text{to 2 Equa-}\\ \text{tions.}\end{array}\left\{\begin{array}{l} b+u-a=y-u-d\\ a+y=c+u\\ \\ \end{array}\right.\left|\begin{array}{l} y=2u+b+d-a\\ y=c+u-a\end{array}\right.$$

therefore $2u+b+d-a=c+u-a$

$$u=c-b-d$$

RULE XII.

(17.) When the Quantity to be (exterminated taken away is of more than one Dimenſion in bot the Equations, the Value of its greateſt Power mu be ſought in both ; and if thoſe Powers are th ſame in both Equations ; if the Equations be mad equal to one another, the higheſt Power will v niſh ; but if thoſe Powers are not the ſame, th Equations that contains the leſſer Power muſt Multiplied by the Quantity to be taken away or by its Square or Cube, *&c.* That it ma become of the ſame Power with the other E quation, then the Values of thoſe Powers are be made Equal, and there will come out a ne Equation, where the greateſt Power or Dimen on of the Quantity taken away is diminiſhed and by repeating this Operation, the Quanti will at length be taken away.

Th

Thus,

$$\left.\begin{aligned} x^2+12x&=4a \\ 2xy-4x^2&=b \end{aligned}\right\} \text{Data}$$

$$\text{by (96, and 97.)} \left\{\begin{aligned} x^2&=4a-12x \\ x^2&=\frac{2xy-b}{4} \end{aligned}\right.$$

---

therefore $4a-12x=\frac{2xy-b}{4}$

$$\text{By (96, 97 and 98.)} \left\{\begin{aligned} 16a-48x&=2xy-b \\ 16a+b&=2xy+48x \\ x&=\frac{16a+b}{2y+48} \end{aligned}\right.$$

$$\left.\begin{aligned} y^3+5y&=a \\ y^3-\frac{10y}{4}&=b \end{aligned}\right\} \text{Data.}$$

$$\text{By (96)} \left\{\begin{aligned} y^3&=a-5y \\ y^3&=b+\frac{10y}{4} \end{aligned}\right.$$

therefore $a-5y=b+\frac{10y}{4}$

$$\text{By (96, and 98)} \left\{\begin{aligned} 4a-20y&=4b+10y \\ \frac{4a-4b}{30}&=y \end{aligned}\right.$$

By the help of theſe Rules (properly apply-ed) the unknown Quantity, or its Powers in a-ny Simple Rquation may be cleared and brought to one Side of the Equation; and the known Quantities to the other Side of the Equation. Therefore the Learner ought to underſtand theſe Rules well, and to Practice them before he pro-ceed to the following Sections.

But when the Powers of the unknown Quan-tity are either mixed with their Root. As $x^3+ax=bb$, &c. or do conſiſt of Different Pow-ers; as $x^3+ax^2=cc$, &c. then they are called affected Equations; the Manner of Reſolving which, that is, the finding the Value of x ſhall be ſhewed in its proper Place.

N. B. We always choſe to repreſent the un-known Quantities by the laſt Letters of the Alphabet, as x, y, z, u, &c. and the known Quantities by the firſt Letters, as a, b, c, &c.

And that the Learner may know how to State two Quantities, their Product, Sum, Difference, Sum of their Squares, or Difference of their Squares, *&c.* we have added the following Ex-ample of the Quantities x and $\frac{y+z}{a}$ of which is the greater.

The Sum of the two Quantities will be $\left\{ x+\frac{y+z}{a} \right.$

Their Difference. $\left\{ x-\frac{y+z}{a} \right.$

The Product of their Multiplication $\frac{xy+xz}{a}$

Th

The Quotient of the greater Dividend by the leſs is $\Big\}\ \frac{ax}{y+z}$

The Quotient of the leſſer divided by the greater. $\Big\}\ \frac{x+z}{ax}$

The Sum of their Squares $xx+\frac{y^2+2xy+yy}{aa}$

The Difference of their Square $xx-\frac{yy+2xy+yy}{aa}$

SECT. XIV.

Of the Uſe of the foregoing Rules in Queſtions producing Simple Equations.

AND firſt of thoſe Queſtions in which there are only one unknown Quantity

QUESTION I.

(108.) To find a Number, to which if it ſelf be dded, and that Sum Multiplied by 10, or *b*, nd from that Product that Number be Sub-racted, and the Remainder Multiplied by 4, or the laſt Product will be equal to 152, or *d*.

$x=$ the Number ſought.
$x+x=2xx=x$ added to it ſelf.
$2x\times b=2bx$ Multiplied by b.
$2bx-x$ x Subtracted.
$2bcx-cx$ is Remain. Mult. by c.
$2bcx-cx=d$ by the *Data*.

By (97) $x=\dfrac{d}{2bc-c}=2$

QUEST. II.

(109.) To find a Number which if Multiplied b it ſelf, and to that Product the Number requir be added, and that Sum Multiplied by 12, o the laſt Product will be equal to the Numb required, Multiplied by 144 or b.

Let $x=$ Number ſought.
$x^2=$ x Multiplied by it ſelf.
x^2+x, x added to the Product.
$ax^2+ax=bx$ by the Queſtion.

$$\text{By}\left\{\begin{array}{l}99\\96\\97\end{array}\right\}\begin{array}{l}ax+a=b\\ ax=b-a\\ x=\dfrac{b-a}{a}=\dfrac{b}{a}-1=11\end{array}$$

QUEST. III.

(110.) Suppoſing the Peudulum of a Clock wh vibrateth Seconds (or 60 times in a Minute) 39. 2 Inches in Length ; how long muſt a P dulum be, to vibrate as often in a Minute as hath Inches in length ?

N. B. *The length of Pendulums are to one ther reciprocally, as the Squares of their Vibrati*

Let $a=60$ the Vibrations performed in one Minute by a Pendulum of the Length of b.

$b=39.2$

$x=$ the Number of Vibrations required.

Square Vibra. : Len. Pen. : : Sq. Vib. Len. Pen.

$$a^2 : b :: x^2 :: \frac{a^2b}{x^2}$$

therefore $\frac{a^2b}{x^2}=x$

And by (98) $a^2b=x^3$

And by (103) $x=\sqrt[3]{a^2b}$

that is $60\times60=3600\times39.2=141120$

and $\sqrt[3]{141120}=52$ near

So that a Pendulum of 52 Inches in Length, will vibrate 52 times in one Minute.

N. B. *Here the Proportion being reciprocal, the Inverſe Rule of* Three *muſt be made uſe of, or elſe the State of the Queſtion ſhould have been thus.* Sq, Vib. : Length Pendulum : : Length Pendulum : Square Vibration.

But this Way the Queſtion is beſt Solved by two nknown Quantities.

QUEST. IV.

(111.) A Man is to give with his Daughter $\frac{1}{7}$ of is Eſtate; if the Number of Pounds the Eſtate s valued at *per Annum* be cubed, the Product, or hat Cube will be a Number expreſſed by nine

Figures or of nine Places, and if that Product b
divided firſt by the Square of 8, and then th
Quotient by the Square of 3, the laſt Quotien
will be equal to 352947.

The Value of the Eſtate is required, as alſo t
Daughters Portion.

Let $\begin{cases} x = \text{the Value of the Eſtat } \textit{per Annum.} \\ a = 352947. \\ b = 8 \\ c = 3 \end{cases}$

then by the Queſt. $\left.\right\} x^3 \div b^2 \div c^2 = a$

then by (989 100) $x = \sqrt[3]{a \times b^2 \times c^2} = 588\ l.$

The Father's Eſtate *per Annum.*

$\frac{3x}{7} = 252$ *l. per Annum*, the Daughters Portion.

QUEST. V.

(112.) The Sum of 4500 *l.* was laid out on t
Surveyor and Work-men of a Publick Buildin
of which the Surveyor had Three-pence for ev
ry Pound that the Work-men received; the Qu
ſtion is how much belongeth to the Survey
and how much to the Work-men?

Let $\begin{cases} 4500 = a \\ 1 = b = \text{one Three-pence.} \\ 80 = c = \text{the Three-pence in 1 Pound.} \\ x = \text{the Sum that belongeth to the Surveyor.} \end{cases}$

Therefore $a - x =$ the Sum that belongeth to he Men.

As $x : a - x :: 1 : c$.

And by (102.) $cx = a - x$

And by 96, and 97.) $\begin{cases} cx + x = a & \quad l. \quad s. \quad d. \\ x = a \div \overline{c + 1} = 55 + 11 + 1\frac{1}{3} \end{cases}$

The Surveyors Wages, which ſubtracted from he whole Sum, leaves $l.\ 4444 + 8 + 10\frac{2}{3}$ for the Workmens Wages.

Quest. VI.

(113.) Any Quantity of Matter being given; o Form thereof a Concave Sphere, whoſe Semiiameter ſhall be equal to the Diſtance of the arth's, and Moon's Centers; and to find the hickneſs of the Shell, encompaſſing that Sphe-ical Concavity.

Let $\begin{cases} a^3 \ \text{The Quantity of Matter.} \\ b = 60 \ \text{Semidiameters of the Earth} = \\ \quad = \text{to the Right Line, that reaches from the Center, to the out Side of the Shell.} \\ p. \text{ to } r. = \text{The Ratio of the Circumference} \end{cases}$

a Circle to its Radius.

Alſo let $x=$ the Semidiameter of the Concavity of the Sphere.

Then $b-x=$ The Thickneſs of the Shell encompaſſing the Concavity of the Sphere.

Then the Solidity of the Cylinder which would circumſcribe the Sphere, the Radius being b, is $=\frac{pb^3}{r}=$ the Solidity of the Cylinder.

The Sphere inſcribed being $\frac{2}{3}$ of the circumſcribing Cylinder, therefore the Sphere inſcribed is $\frac{pb^3}{r}\times\frac{2}{3}=\frac{2pb^3}{3r.}$ and by the ſame Reaſon,

the Sphere whoſe Radius is x is $=\frac{2px^3}{3r.}$, and

the Difference of thoſe two Spheres is to be made equal to the Spherical Shell, or given partical of Matter, and it will ſtand

$$\text{Thus } \frac{2p}{3r}\overline{b^3-x^3}=a^3$$

$$\text{or } b^3-x^3=\frac{3a^3r}{2p}$$

By (96.) $x^3 = b^3 - \frac{3a^3r}{2p}$

By ( ) $x = \sqrt[3]{b^3 - \frac{3ra^3}{2p}}$

So that the Thickneſs of the Sperical Shell, or $b - x$ will be $= b - \sqrt[3]{b^3 - \frac{3ra^3}{2p}}$

Suppoſe the given Quantity of Matter, to be a Solid Sphere of Gold, Whoſe Diameter let be $\frac{1}{10}$ of an Inch.

And let the Solidity of that Sphere be made equal to a^3.

Then by the above *Theorem*, the Thickneſs of the Sphere, whoſe Radius is 240000 Miles, and the whole Subſtance equal to a^3 may eaſily be calculated.

Queſtions in whoſe *Data* there are two unknown Quantities.

QUEST. VII.

(114.) There are two Numbers, the Sum of whoſe Squares is 340 (or a): and the Product made by the Multiplication of the two Numbers, is equal to $\frac{6}{7}$ (or b) Parts of the Square of the greater Number; what are the Numbers?

Let $\begin{cases} x = \text{the Greater.} \\ y = \text{the Leſſer.} \end{cases}$

$$\left.\begin{array}{r} x^2 + y^2 = a \\ xy = \dfrac{6x}{7} \end{array}\right\} \text{Data.}$$

By (99) $y = \dfrac{6x}{7}$

By (105) $y^2 = \dfrac{36x^2}{49}$

By (96) $y^2 = a - x^2$

And by (105) $a - x^2 = \dfrac{36x^2}{49}$

By (98) $49a - 49x^2 = 36x$

(96) $49a = 85x^2$

(97) $\dfrac{49a}{85} = x^2$

(100) $x = \sqrt{\dfrac{49a}{85}} = 14$

$y = 12$

QUEST. VIII.

QUEST. VIII.

(115.) A Merchant bought of two Sorts of Linnen Cloth, 3000 (or *a*) Yards; and if the Number of Yards of the Finer be divided by the Number of Yards of the Coarſer; the Quotient will be equal to 140 or *c*. the Number of Yards, of either ſort is required?

$x=$ the Yards of the Finer.
$y=$ thoſe of the Coarſe.

$$\text{then }\left.\begin{array}{l} x+y=a=3000 \\[1em] \dfrac{x}{y}=c=140 \end{array}\right\}\textit{Data.}$$

$$\begin{array}{l} \text{By (96, and} \\ \quad\text{(98.)} \end{array} \left\{\begin{array}{l} x=a-y \\ x=cy \end{array}\right.$$

$$(105)\ a-y=cy$$

$$(96)\ a=cy+y$$

$$(97)\ y=\frac{a}{c+1}=200$$

$$x=2800$$

So the Number of the Fineſt is 2800 Yards, and of the Coarſeſt 200.

QUEST. IX.

(116.) There are two Numbers, the greater of which hath ſuch Proportion to the leſſer, as 3 to 2, (or *a* to *b*) and the Sum of the ſaid Numbers, hath ſuch Proportion to the Sum of their Squares, as 1 to 13 (or c to d) what are the Numbers?

Let $x=$ greater.
and $y=$ the leſſer.

$$\left.\begin{array}{l} \text{then } x : y :: a : b \\ x+y : x^2+y^2 :: c : d \end{array}\right\}\textit{Data.}$$

$$\text{By}(100)\left\{\begin{array}{l} bx=ay \\ dx+dy=cx^2+cy^2 \end{array}\right.$$

$$\text{By } (97) \quad x=\frac{ay}{b}$$

$$\text{By } (105) \; x^2=\frac{a^2y^2}{bb}$$

Then inſtead of x and x^2 in the ſecond Equation, ſubſtitute their equality and the following Equation will ariſe.

$$\text{By } (104) \; \frac{day}{b}+dy=\frac{ca^2y^2}{bb}+cy^2$$

$$\text{By} \quad \frac{da}{b}+d=\frac{ca^2y}{bb}+cy$$

$$\text{By } (98) \; bbd+bda=ca^2y+b^2cy$$

$$\text{By } (97) \quad y=\frac{bda+bbd}{ca^2+b^2c}$$

QUEST. X.

(117.) Two Men have each a Sum of Money, the one hath 4 times as much as the other, both their Sums put together will not make 100 *l.* but if they be doubled, and from that double, be taken 30 *l.* the Remainder will be twice as much above 100 *l.* as before they wanted of 100 *l.* how much hath each Man?

$$\text{Let}\left\{\begin{aligned} &x = \text{the greater.}\\ &y = \text{the leſſer.}\\ &100 = a\\ &30 = b \end{aligned}\right.$$

$$\left.\begin{aligned} &\text{then } x = 4y\\ &2x + 2y - b - a = 2a - 2x - 2y \end{aligned}\right\}\textit{Data.}$$

$$4x = 3a + b - 4y$$

$$\text{By } (97)\ x = \frac{3a + b - 4y}{4}$$

$$\text{By } (105)\ \frac{3a + b - 4y}{4} = 4y$$

$$\text{By } (98)\ 3a + b - 4y = 16y$$

$$\text{By } (96)\ 3a + b = 20y$$

$$\text{By } (97)\ y = \frac{3a + b}{20} = 16$$

$$x = 16.5 \times 4 = 66$$

QUEST. XI.

QUEST. XI.

(118.) If two Poſt Boys, *A.* and *B.* at 59 Miles diſtance from one another; *A.* rides 3.5 Miles each Hour, *B.* $2.\frac{2}{3}$ Miles every Hour, and *B.* ſet out one Hour later than *A.* to find what Number of Miles *A.* will ride before he meets *B.*

Let
$x=$ the Diſtance *A.* rides before he meets *B.*
$y=$ the Diſtance *B.* rides.
$59=a$ $d=$ to the Miles paſſed over by *A.* before *B.* ſet out.
$3.5=b$
$2.\frac{2}{3}=c$

$$\left.\begin{array}{l} x+y=a-d \\ x:y::b:c \end{array}\right\}\text{Data.}$$

By (96) $x=a-d-y$

(102) $cx=by$

(97) $x=\frac{by}{c}$

(105) $a-d-y=\frac{by}{c}$

(98) $ca-cd-cy=by$

(96) $by+cy=ca-cd$

(97) $y=\frac{ca-cd}{b+c}=24$

$x=a-d-y=31.5$

To which which adding 3.5 the Diſtance rode by *A.* before *B.* ſet out, and the Sum will be 35 Miles for the Diſtance rode by *A.*

or *x* may be found from the *Data.*

Thus,

$$y=a-d-x$$
$$by=cx$$

By (97) $y=\frac{cx}{b}$

By (105) $a-d-x=\frac{cx}{b}$

By (98) $ba-bd-bx=cx$

By (96) $cx+bx=ba-bd$

By (97) $x=\frac{ba-bd}{c+b}=31.5$ to which adding .5, the Space paſſed over by *A* before *B* ſet ut, the Sum will be 35. the whole Diſtance, r Space paſſed over by *A*.

(119.) From the preceeding Example,an univeral Theorem ariſes for finding the Diſtance or pace paſſed over by two Bodies which meet a Point, either when they ſet out both at the me Time, or at different Times. Thus, if *a* e the whole Interval (or Diſtance) of the Places om which they move, and the Velocity of (or Space gone through in any given ime,) be *b* : and the Velocity of *B*, in e ſame Time, be *c* : then if they ſet t both at the ſame Time, the Space paſſed ver by *A*, before he meet *B*, will be $\frac{ba}{c+b}=x$ nd the Space paſſed over by *B*, in the ſame ime, will be $y=\frac{ca}{b+c}$. But if they ſet out at difrent Times, let the Space paſſed over by *A*, fore *B*, ſet out, be repreſented by *d*, then the

Space paſſed over by *B*, before he met *A*, wil
be $y=\frac{ca-cd}{b+c}$ and the Diſtance paſſed over by
A. after *B.* ſet out will be $x=\frac{ba-bd}{c+b}$ to whic
adding *d*, the whole Space paſſed over by *A.* wil
be $\frac{ba-bd}{c+b}+d$.

QUEST. XII.

(120.) The Velocities of two moveable Bo
dies, *A* and *B*, tending to the ſame Place, an
both going over the ſame Space, but with di
ferent Velocities being given; alſo the Interv
of the Times in which they begin to move: Ho
to find the Time when they ſhall overtake one an
ther, as alſo the Space gone over.. Let *A* run
the Rate of 4 Miles an Hour, and let *B* ſet out
Hours after, and run at the Rate of 6 Miles
Hour, the Queſtion is in what Time *B* will ove
take *A*?

$$\text{Let}\begin{cases} x= \text{the Time } B. \text{ ſpent to overtake} \\ 4=a \\ 12=b \\ 6\ =c \end{cases}$$

$a\times b=ab=$ the Miles run by *A*, befo
B ſet out.

Th

Then if $1 : c-a :: x : cx-ax$.

That is if *B*, in one Hour gain 2 Miles, how nuch he will gain in *x* Hours, and it will be

$$cx-ax=ab \text{ by the } Data.$$

$$x=\frac{ab}{c-a}=24 \text{ the Time } B. \text{ ſpent in o-}$$

ertaking *A*. and conſequently $24+12=36$ is the Hours *A* run; and $36\times4=24\times5=144$ the Miles un by each. This univerſal Theorem will ſtill ive the Time, the laſt Body muſt take to o-ertake the firſt, *viz*. The Space gone over by he firſt, before the ſecond ſet out, divided by he Difference of their Velocity's will give the ime the ſecond ſpent to overtake the firſt.

QUEST. XIII.

(121.) If the Sun Moves every Day 1 Deg. and he Moon 13, and at a certain Time the Sun be t the Beginning of *Cancer*, and in three Days fter the Moon at the Begining of *Aries*, the ime of their next following Conjunction is de-nanded and what Degree of the Ecliptick it will e in.

$x=$ the Time the Moon will take to come up with the Sun after being at *Aries*.

$a=93$ Degrees the Diſtance of the Sun before the Moon.

$1=b$ The Velocity of the Sun.

$13=c$ The Velocity of the Moon.

Then by the preceeding Theorem.

$\frac{ab}{c-b}=7\frac{3}{4}$ Days the Moon will require to overtake the Sun, in which Time the Sun will have Moved $7\frac{3}{4}$ Degrees forward, and being before in the third of *Cancer*, therefore the Conjunction will happen in $10\frac{3}{4}$ Degrees of *Cancer*.

SECT. XV.

Of the Compoſition of Quadratick, and Cubick, &c. *Equations.*

(122) *QUadratick* Equations are ſuch (or reducibl to ſuch) as have the Sq. of the unknown Quantity in the firſt Term, and the Root (or that Multiplied into ſome known Quantity) i the ſecond Term, as $x^2+ax=b$.

(123.) *Quadratick* Equations are generated (or a leaſt ſuppoſed to be generated) by the Multiplication of certain Binomials, in which a Quantity looked upon as unknown, is joined at Pleaſure, with others which are known by the Signs + and —.

(124.) As if we conceive the unknown Quantity x, ambiguouſly to repreſent either of theſe 2 Numbers 4 and 5; ſo that x is $x=4$, $x=5$, or $x-4=0$; and $x-5=0$; by Multiplying theſe into one another, this Equation, will ariſe $x^2-5x+4x+20=0$, or $x^2-9x+20=0$, by ſumming up all thoſe Terms in which x is found.

In like Manner if x be equal to $+a$ as alſo to $+b$, or equal to $-a$ and $-b$ it will ſtand thus,

$$1\left\{\begin{array}{l}x-a=0\\x-b=0\end{array}\right. \quad \text{or } 2\left\{\begin{array}{l}x+a=0\\x+b=0\end{array}\right.$$

$$3\left\{\begin{array}{l}x+a=0\\x-b=0\end{array}\right. \quad \text{or } 4\left\{\begin{array}{l}x-a=0\\x+b=0\end{array}\right.$$

The Equation that ariſeth by the Multiplication of the firſt is $x^2-ax-bx+ba=0$; in the ſecond it is $x^2+ax+bx+ba=0$; in the third, $x^2+ax-bx-ba=0$; in the fourth $x^2-ax+bx-ba=0$. Now Suppoſing $-a-b$ which is Multiplied into x, in the firſt to be equal to c, and $+a+b$, in the ſecond to be equal to d, and $a-b$ in the third to be equal to e, as alſo $-a+b$ in the fourth to be equal to h, then the Equations will become equal to theſe four following ones.

$$(1.)\quad x^2-cx+ba=0$$

$$(2.)\quad x^2+dx+ba=0$$

$$(3.)\quad x^2-ex-ba=0$$

$$(4.)\quad x^2+ha+ba=0$$

(126.) In the firſt of which Caſes the Sum of the two Roots ſought is given $=-c$, and in the ſecond $=+d$, and in the third $=-e$, and in the fourth $=-h$, as alſo in each Equation, the Rect-angle (or Product) of the 2 Roots is given; it is required to find the Difference of the Roots, and then each of the ſaid Roots: The Manner of finding all which ſhall be ſhewed in the following *Section.*

(127.) Every Quadratick Equation may have 2 Roots. and every Cubick Equation three, and every Biquadratick four Roots; that is, there may be as many different Values of the unknown Quantity as the unknown Quantity has Dimenſions and no more, which is Plain from the Geration of Powers.

(128.) It is Plain; that if any of the Quantities which were at firſt aſſumed equal to x, be ſubſtituted every where in Place of x, the unknown Quantity; the Sum of all the Terms will ſtill be equal to nothing. But no other Quantity but thoſe at firſt aſſumed equal to x, when ſubſtituted inſtead of x will bring the Equation to nothing.

(129.) Therefore that is the Root of any Equation (whether it be Poſitive or Negative) which being ſubſtituted in the Place of an unknown Quantity, makes the whole Sum equal to nothing.

(130.) For the Quantities which make this are the very ſame, as thoſe which the unknown Quantity x did at firſt, ambiguouſly ſignify; that is, they are its different Values, or in another Word, the Roots of the generated Equation: For Example in a Numerical Equation, $xx-7x+12=0$ produced by the Factors $x-3$ and $x-4$, (where, conſequently the unknown Quantity x,) is to be explained by the Number 3 or 4, if you put 4 in the Place of x, it will then be $16-28+12=0$, or if 3 be put for x, it will then be $9-21+12=0$: For is Evident that the Poſitive Quantity deſtroys the Negative, and that nothing remains. But let 5 be put for x, and then the Equation will be $25-35+12$ which is greater than nothing, and ſo may any other Examples, and any Numbers be tried at Pleaſure; but none of them will bring out the ſame Equation but the two Values of *x*, which in the preceeding Equation are 3 and 4, by which it is evident that the ſaid Equation can have but theſe two Roots, and ſo of any other Quadratick.

(131.) And as Quadratick Equations, ariſe from the Multiplication of two Binomial, or Reſidual Roots, ſo Cubick Equations ariſe from the Multiplication of three Binomial, or Reſidual Roots, each of which being made equal to nothing, and Multiplied continually into one another, a Cubick Equation is produced.

Thus,

$$\text{Let}\left\{\begin{array}{l}x=d\\x=b\\x=c\end{array}\right.$$

Then by Tranſpoſition.

$$\begin{array}{l}x-d=0\\x-b=0\\x-c=0\end{array}$$

And theſe three Reſiduals Multiplied continually into each other, will produce this Equation.

$$\begin{array}{rll} & -d & +bd \\ x^3 & -bx^2 & +bcx-dbc=0 \\ & -c & +dc \end{array}$$

In

(132.) In like Manner the Derivation of Biquadratick Equations ariſeth from 4 Simple, or Lateral Equations reduced (as above) to the Form of Reſiduals, or Binomials, and then continually Multiplied into each other, or elſe from a Cubick into a Lateral, or from one Quadratick into another, or from one Quadratick Multiplied into two Laterals continually. Wherefore every Biquadratick Equation, will have 4 Roots, Real or Imaginary, agreeable to the Dimenſions of its higheſt Power and no more. Thus if the preceeding Cubick be Multiplied by $x+f=0$. this Biquadratick Equation will be produced, *viz.*

$$x^4 \left.\begin{matrix} -b \\ -c \\ -d \\ +f \end{matrix}\right\} x^3 \left.\begin{matrix} +bc \\ +bd \\ +cd \\ -fb \\ -fc \\ -fd \end{matrix}\right\} x^2 \left.\begin{matrix} -bcd \\ +fbc \\ +fbd \\ +fcd \end{matrix}\right\} x - fbcd = 0.$$

(133.) From which Original of theſe Equations, it is plain that after you diſcover the Value of any one Root, you may depreſs the Equation a Dimenſion lower, by dividing it by ſuch Root reduced to the Form of a Reſidual or Binomial as above. Thus if you find that one Root, or one x of the laſt foregoing Equation, is $=-f$; then divide the Equation by $x+f=0$, and it will bring it down to a Cubick; and that Cubick being again divided by $x-b=0$, or $x-c=0$, or $x-d=0$, will be depreſſed into an Original Quadratick, *&c.* And this is ſometimes of good uſe to diſſolve Compound Equations into heir Components.

From this Method of Compoſition of theſe Equations, it is alſo apparent of what Members ach of the Co-efficients are made up.

(134.) For the Co-efficient of the ſecond Term, s always the aggregate or Sum of all the Roots, ith contrary Signs.

Thus, in the Cubick Equation above-mention-d, the Co-efficient of the ſecond Term, is

$\left.\begin{array}{l}-b\\-c\\-d\end{array}\right\}$ And $\left\{\begin{array}{l}-b\\-c\\-d\\+f\end{array}\right\}$ Is the Co-efficient of the ſecond Term of the above Biquadratick Equation:

And $\left\{\begin{array}{l}+b\\+c\\+d\end{array}\right\}$ in the former, And $\left\{\begin{array}{l}+b\\+c\\+d\\-f\end{array}\right\}$ in he latter Equation, is the Sum of all the Roots.

(135.) Wherefore it follows, that if all the Nega-ive Roots, ſecluding their Signs, be equal to all the ffirmative ones; (though not each to each re-pectively) then will the ſecond Term quite va-iſh out of the Equation, and be wanting, be-auſe the Affirmatives and Negatives do natu-ally deſtroy each other. And the contrary, when ver the ſecond Term is wanting in any of theſe quations, the Roots are thus equal, and have ontrary Signs.

(136.) The Co-efficient of the 3d Term, is the gregate of all the Rect-angles, made by the ultiplication of every pair of the Roots (with ontrary Signs) as often as they can be taken, hich in a Cubick is 3, in a Biquadratick is 6, in a fifth Power is 10, *&c.* according to the Order of the Triangular Numbers.

Thus,

In the third Term of the Cubick Equation before mentioned $\left\{\begin{matrix}+bc\\+bd\\+cd\end{matrix}\right\}$ the Co-efficient, is th Aggregate of the three Rect-angles of the Roots *b*, *c* and *d*, taken by Pairs.

And here if all the Negative Rect-angle are equal to all the Affirmative ones, they wil deſtroy one another, and ſo the third Term wil vaniſh, or be wanting.

(137.) The Co-efficient of the fourth Term, i the Aggregate of all the Solids made by the continual Multiplication of all the Ternaries, or every three Roots, with contrary Signs, *&c.* an ſo on, *ad infinitum.*

(138.) As in Quadraticks, the abſolute Number o Quantity given, is a Rect-angle of the 2 Roots or Value of *x*. So in Cubicks, 'tis always th Solid of all the three Roots, with their Sign changed one into another. And in Biquadratick of all the four Roots, *&c.*

(139.) It appears alſo by the Geneſis of Equ How in Equations (all the Roots of which a Real) the Number of the Roots, both Affirmative and Negative may be defin'd.

(140.) For there are as many Affirmative Root as in a continued Series, there are Tranſmutatio of the Signs + into —, and — into +, and conſequently the Reſt are Negative: or (which the ſame) there are as many Negative, as the are pairs of Signs, — and — or + and +, im diately following one another. So in the Equation $x^3-6x^2-51x+280=0$, there are two A firmative Roots, by Reaſon of two changes

t

he Signs, *viz.* of + into —, in the Terms x^3 nd $6x^2$, and of — into +, in the Terms $51x$ nd 280: One alſo is Negative, as is manifeſt y the two Negative Signs.

(141.) And from the ſame Principle, it is alſo evi-ent that the Affirmative Roots of any Equa. are hanged into Negative, and Negative Roots, in-o Affirmative, by changing the Signs of every ther Term of the ſaid Equation, that is, the igns of the ſecond, fourth, ſixth and eighth, *&c.* Terms; or of the firſt, third, fifth, ſeventh, *&c.* Thus, the Signs of the Roots of this Equati-ns, $x^4-4x^3-15x^2+58x-40=0$, are chang-d by writing it thus, $x^4+4x^3-15x^2-58x-$ $0=0$; or thus, $-x^4-4x^3+15x^2+58x+40=0$. And the Signs of the Roots of this Equation, ${}^3+px^2+qx+r=0$, are changed by writing it hus, $x^3-px^2+qx-r=0$; or thus, $-x^3+px^2-qx+r=0$.

(142.) For the further Explanation of the Nature f Roots, let this General Diſtinction of them be bſerved, namely, that they are divided into Real r poſſible) and Imaginary (or impoſſible). Again, f the Real ſome are Affirmative, and ſome Ne-ative, of which alone we have hitherto diſcourſ-d. As to the Impoſſible, we are to know they re neither Affirmative nor Negative, and con-equently the Underſtanding can have no con-eption of them; but all Impoſibility owes its iſe to a Negative Square, and is founded upon his, *viz.*

(143.) That there is no Quantity given, which we an any ways imagine or explain, but if it be Mul-plied into it ſelf, whether it be Negative or Af-rmative, it will make an Affirmative Square.

(144.) Therefore the Root of a Negative Sq. is mething fictitious and impoſſible, as are alſo e Roots of all Negative Powers, which are deſigned by (that is, whoſe Indices are) even Numbers, as they are reduceable to Squares.

(145.) Now hence riſes a neceſſary Limitation, relating to one of the Rules at leaſt, which were brought before, and without which it can by no Means be received as univerſally true: That is, when none of the Roots of an Equation are impoſſible, then we may ſafely judge of the Number of the Affirmative and Negative Roots, by the Signs of the Equation; whereas it may happen, that there may not be as many Affirmative, as there are Variations of the Signs + and —; nor ſo many Negatives, as thoſe Signs are found following one another; for the impoſſible Roots are neither Affirmative nor Negative, as was ſhewn before; and therefore when an Equation ſhall include any of them, the Rule is of no force, except ſo far as you ſhall eſteem them for ambiguous ones.

(146.) For the better Underſtanding of this, we muſt know, that Equa. may be generated by a continual Multiplication, not only of real and poſſible, but alſo of impoſſible and fictious Quantities, as if you ſuppoſe $x=2+\sqrt{-1}$, and $x=2-\sqrt{-1}$ (where the impoſſible Quantity is the Root of Negative Unity) then

$$\text{Multiply } x-2-\sqrt{-1}=0$$
$$\text{by. } x-2+\sqrt{-1}=0$$

There will ariſe the Product $x^2-2x-x\sqrt{-1}-2x+4+2\sqrt{-1}+x\sqrt{-1}-2\sqrt{-1}+1=0$, which is equal to $x -4x+5=0$, and therefore an impoſſible Equation. But this being again Multiplied into $x-2=0$, it will produce the Equation $x^3-6x^2+13x-10=0$; wherefore if you Regard the Signs, three Roots muſt appear at the firſt view but only one of them is real, and the other 2 (as you have ſeen already) are imaginary and impo

ſibl

ſible. So in the Equation $x^3-4xx+7x-6=0$ from the Variations of the Signs, one would imagine there were three Affirmative Roots; (but it ariſes from the Roots 2, $1+\sqrt{-2}$, and $1-\sqrt{-2}$, the two latter of which have the ſame Mark of impoſſibility.

(147.) And hence it may be further concluded, that it is not univerſally True, that there are as many Roots of any Equation, as there are Dimenſions of its higheſt Power; unleſs, you extend the Notion of a Root to every Thing (poſſible, or impoſſible) which you conceive does any way concur to Form an Equation: And indeed it is true, that impoſſible Roots themſelves(as well as the reſt) being ſubſtituted every where in the Place of an unknown Quantity, leave the whole Sum equal to nought, as will be plain to any one who makes trial of it: But if you Mean by a Root only this, what may be explained or underſtood, then the Rule muſt undergo a Limitation; ſince otherwiſe it would plainly appear, in abundance of Caſes, to be falſe and fallacious. But there are one or two Things more to be hinted at, concerning impoſſible Roots, in which we follow the incomparable Sir *Iſaac Newton*, "Since the Caſes of *Problems*, are ſometimes poſſible, but in other Circumſtances altogether impoſſible; for this Reaſon the Roots of Equations ought ſometimes to be impoſſible; for otherwiſe they would repreſent all Problems as poſible in every Caſe without diſtinction.

(148.) So by conſtructing the Equa $zz-az+bb=0$, where if a Circle be deſcribed with a Radius $=\frac{a}{2}$ and the Length of b is ſet off in the Tangent, at the End of which a Perpendicular Line being erected, and produced, will cut the Circle in 2 Points: As long as the Length of the Tangent is leſs then the Radius this Conſtruction will be poſſible; but the Perpendicular will touch the Circle when the Radius and Tangent are equal, and will fall beyond it when the Tang. exceeds the Radius. Thus the Poſſibility, and Impoſſibility of a Conſtruction is truly and juſtly ſhewn by the Equation, in which the Value of the unknown Quantity z is expreſſed (that is $z = \frac{a}{2} + \sqrt{\frac{aa}{4} - bb}$) for according as we ſuppoſe $\frac{a}{2}$ greater or leſſer then b, ſo may the Square $\frac{aa}{4} - bb$ be Affirmative, or Negative, and conſequently the Root of it (and ſo the whole z) is either poſſible or impoſſible.

(149.) The Roots of Equations in themſelves are often-times real and poſſible, when they are not to be explained by Mathematical Figures; that is, when it is impoſſible to exhibit them by Schemes.

The Reaſon of which is, that thoſe Relations, which we imagine Quantities in an Equation, to bear one to another, are too abſtracted and general, to be confined under the narrow limits of Schemes.

As if this Equation be propoſed $\frac{y^2}{a} = x$ in theſe abſtracted Terms; there is nothing meant in this Equation, but that x is a third Proportional to the two Quantities y and a, and this will be always poſſible, the Quantity remaining unvaried, and y varying, nay, increaſing infinitely.

(150.) But if you would explain this very Equa. by the Relation of ſome Lines in a *Geometrical Figure*. For Example, a Circle; Suppoſing the Diameter a, the Chord drawn from its Extremity y, then will x be the Abſciſſe belonging to that Chord.

And here in determining the bigneſs of the Quantity y, you have certain limits ſet you, by the Nature of the Circle, which you cannot go beyond, for it will neceſſarily be leſs than a, otherwiſe you will never have by a Circle, any third Proportional, or abſciſs x.

(151.) But we muſt obſerve, that as the Impoſſibility, owes its riſe to the Nature and Property of a certain Figure; ſo by applying a Figure of a different Nature, it may come to paſs, that there be no Impoſſibility at all found, but that the *Geometrical* Deſignation, may go always with the *Algebraic* Expreſſion.

So in the foregoing Example, if for y you put the Ordinate, and a the Parameter of a Parabola, then will x be the Abſciſſe of the Diameter, agreeing to that Ordinate, and by the Nature of this Figure, whatever Length you take for the Quantity y, you will always aſſign a third Proportional x, within the bounds of the Scheme.

Note, *That the Number of impoſſible Roots is always even.*

For the Number of unequal Roots, which together become equal, is always even; and therefore the Number of them, which come forth Impoſſible after Equality muſt be even; but after what Manner two unequal Roots become equal, that is, two interſections of every Curve, are at the ſame time converted into the Point of Contact, the young Student muſt be Taught from *Geometry.*

Having explained theſe Things, in treating of Equations, we now proceed to Problems, or neceſſary Practices.

ECT. XVI.

The Solution of Quadratick Equations.

IN any of the Caſes of Adfected Quadratick Equations,

(152.) If you add the Square of the Half Co-efficient, or a Quarter of the Square of the whole Co-efficient to each Side of the Equation, that Side on which the unknown Quantity is, will become a compleat Square, whoſe Root will be the unknown Quantity + or — half the Co-efficient, (by IV. PROP. *Euclid* 2.) and that Root will be equal to the Root of the other Side of the
*101 Equation *. Thus in the three Forms of Quadratick Equations.

Equa. propos'd	Squares compleated.	Roots Extracted.
$x^2+ax=b$	$x^2+ax+\frac{aa}{4}=b+\frac{aa}{4}$	$x+\frac{a}{2}=\sqrt{b+\frac{aa}{4}}$
$x^2-ax=c$	$x^2-ax+\frac{aa}{4}=c+\frac{aa}{4}$	$x-\frac{a}{2}=\sqrt{c+\frac{aa}{4}}$
$x^2-ax=-d$	$x^2-ax+\frac{aa}{4}=\frac{aa}{4}-d$	$x-\frac{a}{2}=\sqrt{\frac{aa}{4}-d}$

(127.) What

(153.) Whatſoever known Quantities are Multiplied into the Root or unknown Quantity, they are called the Co-efficients, and where no Quantity is prefixed; Unite is underſtood, and becauſe the Square of Unite is Unite, therefore when Unite is the Co-efficient, $\frac{1}{4}$ muſt be added to each Side of the * Equation to compleat the Square. *152

QUESTION I.

(154.) There are 2 Numbers whoſe Difference is 16 (or *a*) and the Product of their Multiplication is 36 (or *b*) what are the Nunbets.

$$\left\{\begin{array}{l} x = \text{Greater.} \\ y = \text{Leſſer.} \end{array}\right.$$

$$\left.\begin{array}{r} x - y = a \\ xy = b \end{array}\right\} Data.$$

$$\text{By (96 and 97)} \left\{\begin{array}{l} x = a + y \\ x = \frac{b}{y} \end{array}\right.$$

$$\text{By (105) } a + y = \frac{b}{y}$$

$$\text{Qad. 1ſt Form } y^2 + ay = b \text{ By (98)}$$

$$\text{By (152) } y^2 + ay + \frac{aa}{4} = b + \frac{aa}{4}$$

$$\text{By (101) } y + \frac{a}{2} = \sqrt{b + \frac{aa}{4}}$$

$$\text{By (96) } y = \sqrt{b + \frac{aa}{4}} - \frac{a}{2} = 2$$

$$x = 16 + 2 = 18$$

QUEST. II.

(155.) Two Company's of Work-men, whoſe Difference is 40 (or a) have diſtributed among each Company 1200 (or c Pence) where by it happened that the Work-men of the leſſer Company had Five-pence (or d) a piece, more than thoſe of the greater, the Queſtion is to find the Number of Work-men in each Company.

$$\text{Let}\begin{cases} x = \text{greater Company.} \\ y = \text{leſſer.} \end{cases}$$

$$\left.\begin{array}{l} x - y = a \\ \dfrac{c}{x} + d = \dfrac{c}{y} \end{array}\right\} \textit{Data.}$$

$$\text{By (96) } x = a + y$$

$$\text{By (155) } \frac{c}{a+y} + d = \frac{c}{y}$$

$$\text{By (98)} \begin{cases} c + da + dy = \dfrac{ca + cy}{y} \\ cy + day + dyy = ca + cy \end{cases}$$

$$\text{Qad. 1 kind } yy + ay = \frac{ca}{d}$$

$$\text{By (152.) } y^2 + ay + \frac{a^2}{4} = \frac{ca}{d} + \frac{a^2}{4}$$

$$\text{By (101) } y + \frac{a}{2} = \sqrt{\frac{ca}{d} + \frac{a^2}{4}}$$

$$\text{By (96) } y = \sqrt{\frac{ca}{d} + \frac{a^2}{4}} - \frac{a}{2} = 80$$

$$x = a + y = 120$$

QUEST. III

QUEST. III.

(156.) A Merchant bought a certain Number of Pieces of Silks for 270 (or *a*) Pounds, and finds that if he had pay'd that Sum for 5 (or *b*) Pieces fewer, every Piece would have coſt him $\frac{3}{4}$ *l.* (or *c*) more than he paid for each Piece, what was the Number of Pieces?

Let $x=$ the Number of Pieces

than $\frac{a}{x}=$ the Price of each Piece.

alſo $\frac{a}{x-b}$ the Price of each, if 5 fewer.

$\frac{a}{x-b}-\frac{a}{x}=c$ By the *Data*.

By (98) $$\left\{\begin{array}{l} a-\frac{ax+ab}{x}=cx-cb \\ ax-ax+ab=cx^2-cbx \end{array}\right.$$

By (96, and 97.) $$\left\{\begin{array}{l} cx^2-cbx=ab \\ x^2-bx=\frac{ab}{c} \text{ Quadratick 2\textit{d} Form.} \end{array}\right.$$

By (152) $x^2-bx+\frac{bb}{4}=\frac{ab}{c}+\frac{bb}{4}$ the Sq. compl.

By (101) $x-\frac{b}{2}=\sqrt{\frac{ab}{c}+\frac{bb}{4}}$

By (96) $x=\sqrt{\frac{ab}{c}+\frac{bb}{4}}+\frac{b}{2}=45$

QUEST. IV.

(157.) Let 600 (or a) Soldiers be diſpoſed into an Oblong Battle, which the *Colonel* willing to make broader, finds that if he takes away 10 Ranks from the Length, he ſhall augment the Breadth with 2 Ranks, what was the Number of his Soldiers, thro' every Rank, in Length and Breadth?

$x=$ the Number of Men Length.
$y=$ the Number of Men in Breadth

$$\left.\begin{array}{l} x-10 \\ x+2 \end{array}\right\}\text{Multiply together}$$

$$\left.\begin{array}{l} \text{Prod.} = xy+2x-10y-20=600=a \\ xy=600=a \end{array}\right\}\textit{Data.}$$

$$\text{By (97)}\left\{\begin{array}{l} x=\dfrac{a}{y} \\ x=\dfrac{a+10y+20}{y+2} \end{array}\right.$$

$$\text{By (105)}\quad \frac{a}{y}=\frac{a+10y+20}{y+2}$$

$$\begin{array}{l}\text{By (98,} \\ \text{and 96)}\end{array}\left\{\begin{array}{l} ay+2a=ay+10y^2+20y \\ y^2+2y=\dfrac{2a}{10}\ \text{Quad 1}\textit{ſt}\ \text{Form.} \end{array}\right.$$

$$\text{By (152)}\quad y^2+2y+1=\frac{2a}{10}+1\ \text{the Sq. compl.}$$

$y+$

By (101) $y+1=\sqrt{\frac{2a}{10}+1}$

By (96) $y=\sqrt{\frac{2a}{10}+1}-1=10=$ Men in Brea.

$x=60=$ the Men in Length.

QUEST. V.

(158.) A *Grazier* buys Oxen, and Sells them again at 17¾ *l.* (or *a*) *per* Ox, and then found that by every 100 *l.* (or *c.*) that he laid out, he gained as many Pounds as he paid for one Ox, what was the firſt coſt of each Ox.

$x=$ the firſt Coſt of each Ox.

then $a-x=$ the gain *per* Ox.

$$x : a-x :: c : \frac{ca-cx}{x}$$

$\frac{ca-cx}{x}=x$ by the *Data*.

By (98) $ca-cx=x^2$

By (96) $ca=x^2+cx$

Square compl. $x^2+cx+\frac{cc}{4}=ca+\frac{cc}{4}$

$x+$

By (101) $x+\frac{c}{2}=\sqrt{ca+\frac{cc}{4}}$

By (96) $x=\sqrt{ca+\frac{cc}{4}}-\frac{c}{2}=15\,l.$

So that the Price of an Ox, was 15 *l.*

QUEST. VI.

(159.) A Merchant bought 90, (or a) Pounds of Sugar, and 40 (or b) Pounds of Ginger, for 42 (or c) Pounds; and finds that in laying out 1 Pound (or d) upon each Sort he hath $\frac{1}{3}$ (or e) of a Pound of Ginger more than of Sugar, what was the Price of the Pound of each?

Let $x=$ Sugar for one Pound.
$x+e=$ the Ginger for one Pound.

Value $\frac{a}{x}=$ the whole Price of the Sugar,

Value $\frac{b}{x+e}=$ the Price of the Ginger.

$\frac{a}{x}+\frac{b}{x+e}=c$ By the *Data.*

By (98) $\left\{\begin{array}{l} a+\frac{bx}{x+e}=cx \\ ae+ax+bx=cx^2+cex \end{array}\right.$

cx^2+

By (96) $cx^2 + cex - ax - bx = ae$

Qad. 2*d* Form $\left\{\begin{array}{l} x^2 + \frac{cex - ax - bx}{c} = \frac{ae}{c} \\ \text{or } x^2 - \frac{58}{21}x = \frac{5}{7} \end{array}\right.$

Then for the Co-efficient $\frac{ce - a - b}{c}$ if you take m, the Equation will ſtand thus.

$x^2 - mx = \frac{ae}{c}$ Quad. 2*d* Form.

By (152) $x^2 - mx + \frac{m^2}{4} = \frac{ae}{c} + \frac{m^2}{4}$

By (101) $x - \frac{m}{2} = \sqrt{\frac{ae}{c} + \frac{m^2}{4}}$

By (96) $x = \sqrt{ae + \frac{m^2}{4}} + \frac{m}{2} = 3lbs.$ Sugar for 1 Pound.

and $3\frac{1}{3}$ Pounds Ginger for 1 Pound.

QUEST. VII.

(160.) There are two Numbers, the Sum of whoſe Squares is 20 (or *a*) and the Product of their Multiplication added to the Sq of the Leſſer Number makes 12 (or *b*) what are the Numbers?

$$\text{Let}\left\{\begin{array}{l} x = \text{the Greater.} \\ y = \text{the Leſſer.} \end{array}\right.$$

$$\left.\begin{array}{l} x^2 + y^2 = a \\ xy + y^2 = b \end{array}\right\} \textit{Data.}$$

By (97) $x = \frac{b - y^2}{y}$

By (100) $x = \sqrt{a - y^2}$

By (105) $\frac{b - y^2}{y} = \sqrt{a - y^2}$

By (100) $\frac{b^2 - 2by^2 + y^4}{y^2} = a - y^2$

By (98) $b^2 - 2by^2 + y^4 = ay^2 - y^4$

By (96) $2y^4 - 2by^2 - ay^2 = -b^2$

Eq. 3*d* Form $y^4 - by^2 - \frac{a}{2}y^2 = -\frac{b^2}{2}$

that is $y^4 - 22y^2 = -72$
then let $22 = c$ and $-72 = d$

Sq. compl. $y^4 - cy^2 + \frac{cc}{4} = \frac{cc}{4} + d$

$$y^2 - \frac{c}{2} = \sqrt{\frac{cc}{4} - d}$$

$$y^2 = \frac{c}{2} \pm \sqrt{\frac{cc}{4} - d}$$

$y = \sqrt{\frac{c}{2} \pm \sqrt{\frac{cc}{4} - d}} = 2$ and $x = 4$.

When

(161.) When a Quadratick Equation has 2 real Roots, and one of them is found by the preceeding Rule *. The other may be found by Dividing the given Equation by the unknown Quantity + or — the Root found. Thus let the given Equation be $x^2+8x=48$ then $x=\sqrt{48+16}-4=+4$ By (152).

*152

Then divide the given Equation by $x-4$ Thus,

Diviſor) the given Equa. (the Quotient.
$x-4$) $x^2+8x-48=0$ ($x+12=0$
x^2-4x

$+12x-48$
$+12x-48$

Therefore $x=-12$ is the other Root of the given Equation, and thoſe two Roots, $x=4$ and $x=-12$ Tranſpoſed, Thus, $x-4=0$ and $x+12=0$; and Multiplied together will produce the given Equation.

SECT. XVII.

The Solution of Cubick, and Biquadratick, &c. *Equations by converging Series.*

THere are ſeveral Methods of reſolving, or finding the Roots of Cubick Equations, ſuch as by Trials, to find one of the Roots, and if the Equation be divided by the unknown Quantity + or — that Root, the Equation will be reduced to a Quadratick, whoſe Roots may be found by the Rules of the preceeding *Section*, and conſequently all the Roots of the given

ven Cubick Equation will be found; but this Method of reſolving Cubick Equations by Trials is vaſtly tedious, and not Mathematical.

Another Method of reſolving Cubick Equations, is by Subſtitution, which Method only ſerves to give the Roots of ſome particular Equations, and therefore is not univerſal. The moſt *Geometrical* Method of Solving Cubick Equations, is by Conſtruction, by the help of the Parabola and Circle, but where the Co-efficients are great, this Method is impracticable; becauſe the Parameter of the Parabola, in the Conſtruction muſt always be made equal to Unite, and from the ſame Scale, from which that Unite was Meaſured, the Co-efficient Multiplied into the Square of the Root ſought, muſt be applied at Right Angles, to the Axis of the Parabola, as an Ordinate, and if that Co-efficient be great, the Parabola muſt be vaſtly large, otherwiſe the Co-efficient cannot be Meaſured to any exactneſs. For Suppoſe, that for the Parameter (or Unite) $\frac{1}{10}$ of an Inch be taken, then from the Vertex to the Focus, will only be $\frac{1}{40}$ of an Inch, and if the Co-efficient of the Square of the unknown Quantity be 300, the Parabola muſt be continued till the an Ordinate applied to the Axis be 30 Inches, before the Co-efficient can be Meaſured, allowing an Unite to every $\frac{1}{10}$ of an Inch, and then the Abſciſſe will be 9000 Inches long, becauſe the Square of the Ordinate, is equal to the Abſciſſe, multiplied into the Parameter, and that it is impracticable to make ſuch a Parabola is apparent. Therefore the Rule for Reſolving Cubick Equations, by Conſtruction with the Parabola and Circle can only be made uſe of, when the Co-efficients are very ſmall.

Another way of Reſolving Cubick Equations, is by deſtroying the ſecond Term, which is very difficult and tedious for a Learner, and not ſo univerſal, as the Solution of them by Converging Series, which is the Method we ſhall in this Place make Uſe of, for Reſolving Cubick, Equations and may be made Uſe of, to Reſolve all other Equations, of whatever Degree, or Height.

(162.) Mr. *Ralphſon*'s Method, in raiſing particular *Theorems*, for extracting the Roots of all Equations whatſoever, is as follows, *viz.* He Suppoſes the Root in any Equation to be equal to a Binomial of a, a known, and y an unknown Quantity; and then ſubſtitutes the ſaid Binomial $a+y$, and its Reſpective Powers, for x the Root, and the Roots Reſpective Powers in the given Equation; then rejects (or leaves out) all the Members of the new Equation, wherein there is any of the Power of y (exceeding the Root) and with the other Members makes a ſuppoſed Equation, and thereby finds the ſuppoſed Value of y the Converging Part, which Value of y, will be Affirmative, if the Quantity a was taken leſs than the Root or Value of x, and therefore to be added to the Quantity a, which Sum will be a new Value of a; but if the Value of a was taken greater, then the Root or Value of x, the Quantity y will be Negative, and therefore to be ſubtracted from the Value of a and the Remainder will be a new Value of a equal to x.

The *Theorem* for Extracting the Root of a Quadratick Equation is formed thus.

EXAMPLE I.

(163.) Let $x^2=2$ be a Simple Quadratick, whoſe Root x is required;

Let $\begin{cases} a+y=x \\ b=2 \end{cases}$

Then will $a^2+2ay+y^2=x^2=b$

*162 and if y^2 be rejected, * the Equation will be $a^2+2ay=b$

and by (96 and 97) $y=\dfrac{b-a^2}{2a}$ the *Theorem* for Extracting the Root of the given Equation.

Suppoſe $a=1$

Then will $a^2=1$

Then by the *Theorem* $\dfrac{b-a^2}{2a}=2-1\div2=0.5=y.$

which being Affirmative muſt be added to a, for a new Value of a.

hence $1+0.5=1.5=a.$

Then $a^2=2.25$

$2a=3$

Therefore repeating the *Theorem* $\frac{b-a^2}{2a}=2-2.25=-0.25\div 3=-0.083$. which being Negative, muſt be ſubtracted from the laſt Value of *a*.

Thus,
$1.5-0.083=1.417=a$, a new Value of *a* for a 3*d* Opperation.

$a=1.417$

$a^2=2.007889$

$2a=2.834$

Then repeating the *Theorem* $\frac{b-a^2}{2a}=2-2.007889\div 2.834=-0.002783=y$ which being Negative muſt be ſubtracted from the laſt Value of *a*. Thus $1.4117-0.002783=1.414217=x$ the Root required, but if the Value of x were more accurately required, this Value of x would become a new Value of *a*, and after this Method you might proceed till you come infinitely near the Truth.

(164) The *Theorem* for Extracting the Cube Root may be raiſed thus.

EXAMP. II.

If $x^3=13=b$

and $x=a+y$

Then will $a^3+3a^2y+3ay^2+y^3=x^3=b$

And

*162 And by rejecting $+3ay^2+y^3$ * the Equation will ſtand Thus, $a^3+3a^2y=b$.

And by (96 and 97) $y=\frac{b-a^3}{3a^2}$ the *Theorem* for Extracting the Cube Root.

Suppoſe $a=2.3$

then will $a^3=12.167$

and by the *Theorem* $\frac{b-a^3}{3a^2}=13-12.167\div15.87=0.05=y$ which being Affirmitive muſt be added to a, that is $2.3+0.05=2.35=$ to a new Value of a.

Then $a^3=12.977875$.
and $3a^2=16.5675$.

And repeating the *Theorem* $\frac{b-a^3}{3a^2}=$

$=13-12.977875\div16.5675=0.001333=y$, the ſecond approach, which added to the firſt approach, or the laſt Value of a, is $2.45+0.001333=2.351333$. The Cube Root of 13 very near the Truth, and done with near 100 Figures fewer than in the common way of Extraction.

(165.) To make the *Theorem*, for reſolving an affected Cubick Equation.

Let the given Cubick Equation be

$x^3+13x^2-10x=400=b$

$=x^3+cx^2-dx=b.$

Let $a+y=x$

$$\text{then}\left\{\begin{array}{l}a^3+3a^2y+3ay^2+y^3=x^3\\ ca^2+2cay+cy^2=cx^2\\ -da-yd=-dx\end{array}\right.$$

That is $a^3+3a^2y+3ay^2+y^3+ca^2+2cay+cy^2$

$-da-dy=b.$

and by casting away * every Step in which any Power of y is, above the Root, (or y) this following Equation will remain, *viz.* *162

$$a^3+3a^2y+ca^2+2acy-da-dy=b$$

And by (96 and 97) $y=\dfrac{b-a^3-ca^2+da}{3a^2+2ac-d}$

which is the *Theorem* for finding the Value of y.

Let us take $a=4$, then $-a^3=-\ 64$

$-ca^2=-208$

which added make $=-272$

$+b$

$+b=+400$
$+da=+40$

Sum is $+440$

Then from $+440$
Subtract -272

Remains $+168$ for a Dividend.

$+3a^2=+48$
$+2ac=+104$

Sum is $+152$
Subtract $-d=-10$

Remains 142 for a Diviſor.

Then 168 being Divided by 142, the Quotient is 1, that is $y=1$ which being Affirmative, muſt be added to a, which was 4, and it will become $a=4+1=5$.

And to know whether 5 be one of the Roots of the given Cubick Equation, make $x=5$ and by Tranſpoſition $x-5=0$. and then Divide the given Cubick Equation by $x-5$.

Thus,

$$\begin{array}{r|l|l}
x-5 & x^3+13x^2-10x-400 & x^2+18x+80 \\
 & x^3-5x^2 & \\
\hline
 & +18x^2-10x & \\
 & +18x^2-90x & \\
\hline
 & +80x-400 & \\
 & +80x-400 & \\
\hline
 & 0 &
\end{array}$$

And the Quotient gives this Quadratick Equation $x^2+18x=-80$, which reſolved by the Rules in the preceeding Section, the Roots of it will be found to be -10 and -8. Therefore the 3 Roots of the given Cubick Equation are $+5$, -10, -8, either of which, and its reſpective Powers, being ſubſtituted, inſtead of x, and its Powers, will bring the given Equation to nothing, therefore * thoſe Numbers are the Roots required. *127

Bur if there had been any Remainder, when the given Cubick was divided by $x-5$, then in that Caſe, 5 would not have been one of the Roots of the given Equation, and then a muſt have been made equal to 5, and by the *Theorem* * a new Value of y, might have been found as in the following Examples. *162

Examp. III.

(165) Let $x^3-7x^2-220x=800=x^3-cx^2-dx=b$ be the given Equation whoſe Roots are required?

Suppoſe as before $a+y=x$

$$\text{then}\left\{\begin{array}{l} a^3+3a^2y+3ay^2+y^3=x^3 \\ -ca^2-2cay-cy^2=-cx^2 \\ -da-dy=-dx \end{array}\right.$$

that is, $a^3+3a^2y+3ay^2+y^3-ca^2-2cay-cy^2-$ $da-dy=b.$

And by leaving out all the Quantities in which
*162 any of the Powers, above the Root of y * are
found, the Equation will ſtand Thus,

$$a^3+3a^2y-ca^2-2cay-da-dy=b$$

And by (96 and 97.) $\Big\}$ $y=\dfrac{b-a^3+ca^2+da}{3a^2-2ca-d}$

The *Theorem* for finding the Value of y.

Suppoſe $a=16$
then $-a^3=-4096$

$+3a^2=768$

$-2ac=-224$
$-d=-220$

Sum Nega. -444

from $3a2=768$
Subtract -444

Rem. for a Div. 324

$+b=800$
$+ca^2=1792$
$+da=3520$

Sum Poſ. 6112
Subtract -4096

Dividend 2016

Then 2016 Divided by 324 the Quotient, is $6=y$ which being Affirmative muſt be added to 16 the Value of a, the Sum is 22 for a new Value of a, for by Trial it will be found that 22 is none of the Roots of the given Equation. Therefore to repeat the *Theorem.*

$+3a^2=1452$

$-2ac=-308$
$-d=-220$

S. of the Neg. -528
Subtract. from 1452

Leaves for a Div. 924

$a=22$

$-a^3=-10648$

$+b=800$
$+ca^2=3388$
$+da=4840$

Sum of the Poſi. } 9028
Subtract -10648

for Divid. -1620

Then —1620 Divided by +924, gives — 1 $= y$ for the Quotient which being Negative muſt be ſubtracted from 22 the former Value of a, and there Remains 21 for a new Value of a, and to repeat the *Theorem.*

$+3a^2 = 1323$

$-2ca = -294$

$-d = -220$

Sum of the Nega. —514
Subtracted from 1323

Diviſor. 809

$a = 21$

$-a^3 = -9261$

$+b = 800$

$+ca^2 = 3087$

$+da = 4620$

Sum of the Poſi. 8507
Subtract —9261

Rem. for a Divid. —754

And by Dividing —754 by 809 the Quotient will be almoſt —1 equal to y, which being Negative is to be Subtracted from 21 the laſt Value of a, and here it is to be obſerved, that though the Diviſion of —754 by 809, does not amount to one, yet it is to be taken as ſuch in Order to make a Trial, that it may be diſcovered whether the Root required be a whole Number or Fraction.

Thus,

$$21 - 1 = 20 = x.$$

Then by dividing the given Equation, $x^3 - 7x^2 - 22x - 800 = 0$; by $x - 20$ the Quotient will be $x^2 + 13x + 40 = 0$. And the Roots of this

Quadratick Equation will be found —5 and —8, by the Rules in the preceeding *Section.* Therefore the Roots of the given Cubick Equation are 20, —5, —8.

EXAMP. IV.

(166.) Let it be required to find one of the Affirmative Values of x in this adfected Cubick Equation.

$$x^3+438x^2-7825x-98508430=0$$
$$=x^3+cx^2-dx=b$$

The *Theorem* raiſed as in the preceeding *Example* is, $\Big\}\ y=\frac{b-a^3-ca^2+da}{3a^2+2ca-d}$

To find the Value of y.

Suppoſe $a=300$.

$+3a^2=270000$
$+2ca=362800$

The Sum is 632800
Subtract —7825

Remains for a Diviſor. $\Big\}$ 624975

Then $-a^3=-27000000$
$-ca^2=-39420000$

Sum —66420000

$+b=98508430$
$+da=2347500$

Sum 100855930
Subtract —66420000

For a Dividend 34435930

Then 34435930, Divided by 624975, gives 55 $=y$ in the Quotient, which being Affirmative muſt be added to 300, the firſt Value of a, which gives 355 equal to the ſecond Value of a, and by repeating the *Theorem* ſeveral Times $a+y$ will be found to be $=356.97089681=x$ the Root required very near.

EXAMP. V.

(167.) Let one of the Affirmative Values of x, be required in this Biquadratick Equation, *viz.* $x^4-80x^3+1998x^2-14937x=-5000=x^4-cx^3+dx^2-ex=-b$.

To Form the *Theorem*,

Suppoſe $a+y=x$

$$\begin{array}{l} a^4+4a^3y+6a^2y^2+4ay^3+y^4=x^4 \\ -ca^3-3ca^2y-3cay^2-cy^3=-cx^3 \\ +da^2+2day+dy^2=dx^2 \\ -ea-ey=-ex \\ \hline \end{array}$$

And by leaving out all the Quantities, in which any of the Powers of y are found above its Root, the Sum of the Reſt will ſtand Thus,

$a^4+4a^3y-ca^3-3ca^2y+da^2+2day-ea-ey=-b$.

And by (96, and 97.) $\left\{ y = \dfrac{-b - a^4 + ca^3 - da^2 + ea}{4a^3 - 3ca^2 + 2da - e} \right.$

This being the *Theorem* for finding the Value of *y*, let us Suppoſe $a = 12$.

$6912 = 4a^3$
$47952 = 2da$

Sum Poſi. 54864

$-34560 = -3ca^2$
$-14937 = -e$

S. Neg. -49497

From Poſ. 54864
SubNeg -49497

Rem. Div. 5367

$-5000 = -b$
$-20736 = -a^4$
$-287712 = -da^2$

-313448 Sum Neg.

$138240 = +ca^3$
$179244 = +ea$

$317484 =$ SumPoſ.
-313448 { SumNeg. Subtract.

4036 Rem. is a Divdend.

Then Dividing 4036 by 5367 the Quotient is 0.7 which being Poſitive muſt be added to the former Value of *a*, *viz.* $12 + 0.7 = a$.

Then to find a new Value of *y*, the *Theorem* muſt be repeated

Thus,

$a = 12.7$

$-5000 = -b$
$-25614.4641 = -a^4$
$-322257.42 = -da^2$

Sum of the Nega. -352871.8841

$163870.640 = +ca^3$
$189699.9 = +ea$

Sum of the Poſitives 353570.540
From the Poſitives 353570.540
Subtract the Negat. $-$ 352871.8841

Remains the Dividend 698.6559

$8193.532 = 4a^3$
$40649.2 = 2da$

Sum Poſitives 48842.732

$-38709.160 = -3ca^2$
$-14937 = -e$

Sum of the Nega. -53646.160
Subtract the Poſi. 48842.732

Remains for a Div. -4803.428

Then 698.6559 being Divided by -4803.428. the Quotient will be -0145. which being Negative, muſt be ſubtracted from 12.7

the laſt Value of a, and the Remainder is 12.6855 for the Value of x very near.

(166.) After the ſame Manner, *Theorems* may be formed to find the Roots of Equations of the 5*th* or 6*th* Power, or of any given Power.

For the *Theorem* for the 5*th* Power will be

$$y = \frac{\pm b \pm a^5 \pm ca^4 \pm da^3 \pm ea^2 \pm fa}{5a^4 \pm 4ca^3 \pm 3da^2 \pm ea \pm f}$$

And for the 6*th* Power the *Theorem* is

$$y = \frac{\pm b \pm a^6 \pm ca^5 \pm da^4 \pm ea^3 \pm fa^2 \pm ga}{a^5 \pm 5ca^4 \pm 4da^3 \pm 3ea^2 \pm {}^2fa \pm g}$$

And ſo for any other Power, *Theorems* may be formed.

And it is to be obſerved, that the Signs of thoſe Quantities of the *Theorem* that are above the Line, each reſpectively is the Reverſe of the Signs in the given Equation; and the Signs of the Quantities of the *Theorem* below the Line, are the ſame with the Signs of the given Equation, for which the *Theorem* is made.

The Famous Dr. *Halley* found two univerſal *Theorems* for Evolving Equations, the one Rational, and the other Irrational, which converge faſter than thoſe of Mr. *Ralphſon*'s Theorems; for every Renewal of each of Dr. *Halley*'s Theorems,

rems, triples the true Figures in the Value of a; but thoſe *Theorems* of Mr. *Ralphſon*'s, are eaſier for the Learner to begin with; and when once the Learner underſtands thoſe of Mr. *Ralphſon*, Dr. *Halley*'s will be equally eaſie, which for Brevity's Sake, I muſt refer the Reader to, in *Phil. Tranſactions* Number 210.

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ERRATA.

PAge 8 *l. ult. for* Qualities, *r.* Quantities. *p.* 15 *l.* 3 *for* $2xy$ *r.* $2x^3y$. *p.* 17 *l. ult. for* xa *r.* x^2a. *p.* 18 *l.* 13 *for* 38 *r.* 36. *p.* 21 *l.* 12 *for* $-\frac{1}{4}x^4b$ *r.* $-\frac{1}{4}x^4y$. *p.* 32 *l.* 15 *for* $x+y^2$ *r.* x^5y^2. *p.* 44 *l.* 8 *for* $4ab-)9a^3b+aab$ r. $3ab-)ba^3b+9aab6$. *p.* 61 *l.* 3 *for* $\frac{x+z}{ax}$ r. $\frac{y+z}{ax}$ *p.* 69. *l.* 5. and 10 *for* 140 *r.* 14.

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FINIS.